ENGINEERING NEWS-RECORD

OCTOBER 17, 1946

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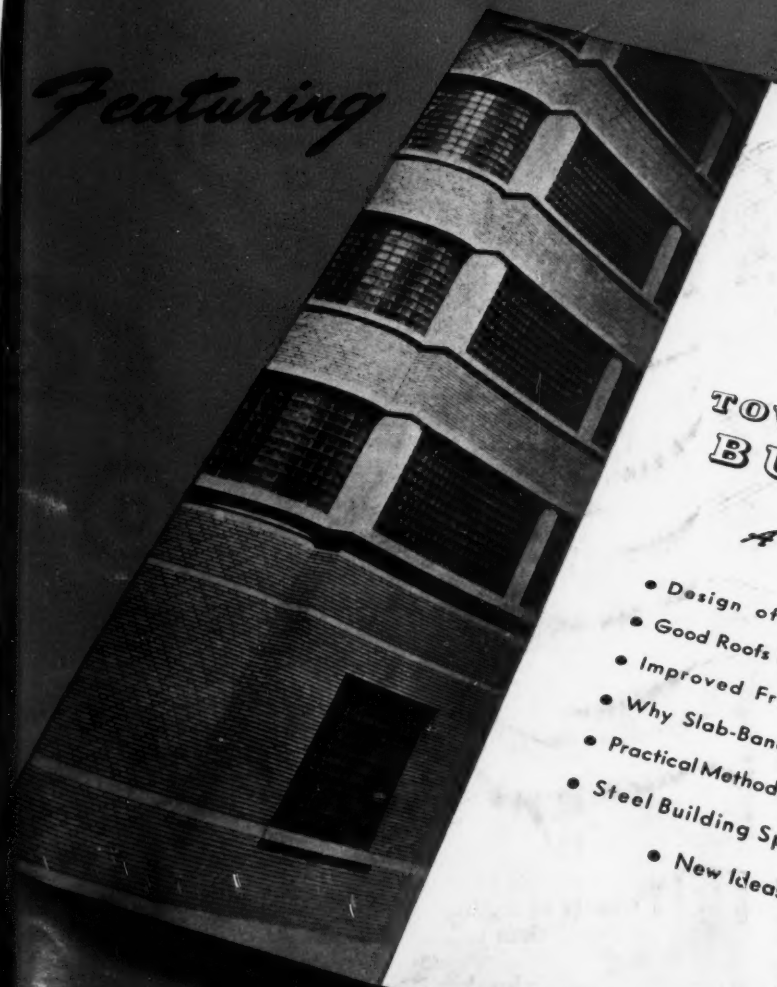

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- Design of Industrial Laboratories
- Good Roofs Require More Than Mopping
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Volume 137 • Number 16 — October 17, 1946

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FEATURES IN THIS ISSUE

News of the Week..... 85

Editorials 92

Armor Coated Highway Construction in Nebraska..... 94

Special Equipment for Pulling Concrete Piles..... 98

Temperature Effects Studied on Welded Girders.....L. GROVER 100

Heavy Deposit Leached from Concrete Found in Dam..... 101

Major Heavy Duty Concrete Runway..... 102

Cement Mortar Used to Reline Water Main.....G. W. JONES 104

Suspension Bridge Cables Last 90 Years..... 106

TOWARD BETTER BUILDING—A SPECIAL SECTION

Design of Industrial Laboratories.....W. W. FENNER 108

Good Roofs Require More Than Mopping.....E. A. SWENSON 113

Guides to Improved Framed Walls for Houses.....A. D. FREAS 117

Practical Methods to Avoid Cracked Walls.....T. H. MC KAIG 121

Why Slab-Band Floors Are Economical.....F. N. SEVERUD 124

Steel Building Specification Changes Analyzed.....T. R. HIGGINS 127

New Materials for Housing Under Study..... 132

DEPARTMENTS

Construction Trends..... 83

Comment and Discussion..... 135

Unit Prices 139

New Aids 144

Manufacturers Activities 154

Manufacturers Publications..... 161

Elections and Activities..... 169

Men and Jobs..... 174

Construction Reports..... 213

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Allocation of plywood to meet the needs of the Reconversion Housing Program means that a large proportion of the Douglas fir plywood industry's production must go to housing contractors, stock cabinet manufacturers, prefabricators and distributors.

Naturally, the supply situation for all other industrial and construction uses is temporarily acute.

It is a fact, however, that more plywood is being produced today than in pre-war years. So once the present overwhelming demand has been met, an increased amount will be available.

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Construction Trends

Construction Wage and Price Rises Low in War Distorted Price Structure

Construction men, coping with rising prices, will get small comfort from the farm and industrial price structure inherited from the War, for they are even higher than construction prices.

From January 1941 to June 1946 hourly skilled construction wages went up 22 percent and hourly common labor construction wages rose 45 percent, while hourly factory skilled and unskilled wages, reported by the Bureau of Labor Satistics, increased 60 percent. The Bureau of Labor Statistics wage series does not report skilled and unskilled manufacturing wages separately.

The 22 percent rise in construction skilled wages compares with a 55 percent rise in hourly skilled and semi-skilled manufacturing wages reported by the National Industrial Conference Board, construction wages climbing from $1.469 in January 1941 to $1.798 in June, 1946, and manufacturing from $0.851 to $1.320.

The 45 percent rise in construction common labor wages compares with a 61 percent rise in manufacturing unskilled as reported by the Conference Board. Here construction common wages went up from $0.711 to $1.034 in June, 1946 and manufacturing unskilled from $0.630 to $1.017.

In November, 1943 the common labor rate for construction, $0.869 per hour, ENR 20-cities average, was topped by the manufacturing unskilled average $0.871 as reported by the Conference Board. Then, for the first time construction labor lost entirely the higher hourly pay increment that formerly compensated construction workers for seasonal losses in employment.

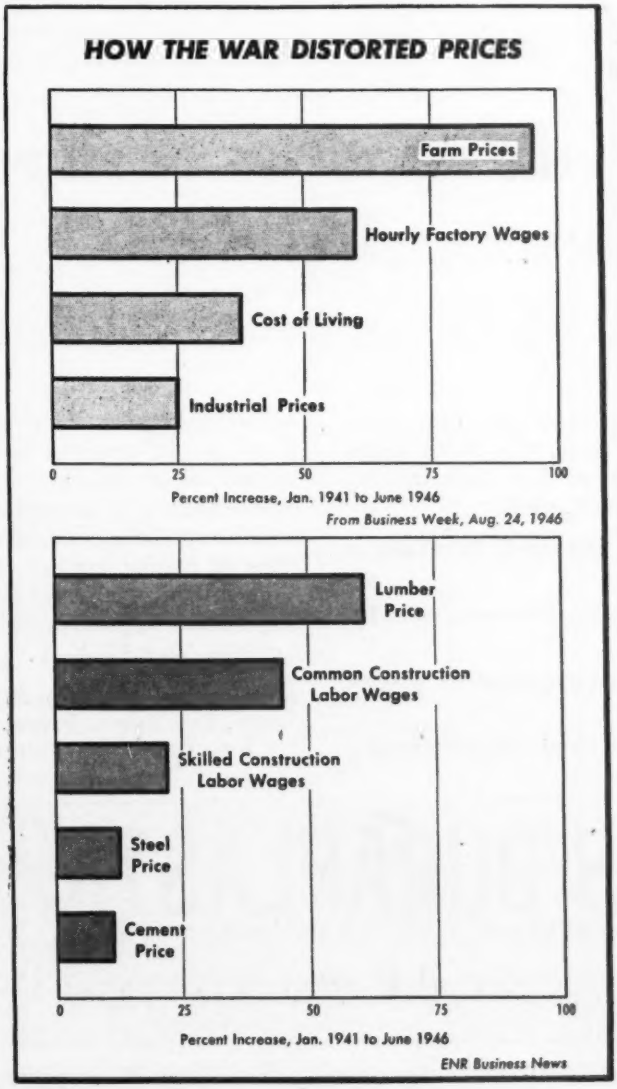
Since construction, with employment currently reported at 2,296,000 by the Bureau of Labor Statistics, is face to face with the necessity of attracting new workers to the industry, this war distortion in the relation of factory and field wages cannot help but increase the difficulties of recruiting new construction workers.

Of the basic construction materials, lumber prices have increased most—61 percent (ENR 20-Cities Aver.) This compares with 11 percent for cement, 12 percent for steel. But against the general economic background reported by *Business Week*, these construction materials price increases compare with a rise in farm prices of 96 percent and in industrial prices of 96 percent.

The ENR building cost index, which combines lumber, cement and steel prices with hourly skilled labor wages, rose 27 percent from January 1941 to June 1946, and the ENR construction cost index, reflecting these material prices but common labor hourly wages increased 39 percent.

These trends in construction prices and wages compare with a 38 percent rise in the cost of living index, computed by the Bureau of Labor Statistics, with the Mitchell Committee adjustment.

That construction prices have continued to rise sharply since June is understandable against this background of considerably greater increases in industrial and farm prices.



Administration Building, McLaughlin Field, Hot Springs, Arkansas. Architects, Erhart, Eichenbaum and Rauch, Little Rock; contractors, Peterson & McFadyen, Little Rock; ready-mixed concrete furnished by C. J. Horner Co., Hot Springs.

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News of the Week

ENGINEERING NEWS-RECORD • OCTOBER 17, 1946 • VOLUME 137 • NUMBER 16

Engineering employees meet to form national agency

Local associations set up for collective-bargaining purposes lay groundwork for a national federation

Representatives of associations of professional employees from various cities on the West Coast met in San Francisco Oct. 5-7 for the formation of a national organization to bear the name National Professional Association of Engineers, Architects and Scientists. The purpose of the proposed national association, according to spokesmen for the groups, is to bring such groups throughout the country together in one organization for mutual aid in solving their common problems, to achieve agreement as to general principles and procedures, and to gain the advantages of concerted effort in the attainment of their objectives.

The seven associations officially represented have a total membership of about 2,000. All were created originally under a plan drawn up by the American Society of Civil Engineers for aiding engineering employees to set up their own collective-bargaining groups, but all now are entirely independent of the ASCE. Their objectives are to promote and protect the economic welfare and professional status of their members and the right of professional employees to bargain collectively through agencies of their own choosing.

All professionals eligible

Although the groups represented at the meeting are made up of professional engineering employees, the new organization undertakes to represent all professional technical employees. The definition adopted by the meeting is that a professional employee is "an employee who possesses a knowledge of materials, equipment, mathematics or the physical and natural sciences and who applies such knowledge in the planning, design, construction, development, or use of structures, machines, products, processes, or projects and whose work is primarily intellectual and requires the exercise of judgment, is creative and is of such character that the output produced or the result accomplished cannot be standardized."

Basic questions of policies, objectives, qualifications for membership, structure of the organization and scope of its activities were debated at length. Agreements were reached as the basis for drafting a constitution and a drafting committee was appointed headed by Ralph W. Hutchinson of Sacramento. This committee, all members of which are from Sacramento, will take the minutes of the San Francisco meeting, which in effect are instructions to this committee, and draft a constitution for submission to the constituent bodies.

Spokesmen for the organization would not estimate the time necessary for final drafting of the proposed rules.

In addition to designating a method for ratifying the constitution when drafted, the San Francisco meeting provided a means for new groups that conform to the standards as set up to be taken into the national organization.

The San Francisco meeting was the second such gathering, the first having been held in Spokane in July. The following officers, elected in Spokane, are to continue in office until the first convention of the new organization: Sterling S. Green, Los Angeles, chairman; Trygve W. Hoff, Seattle, vice-chairman; and Donald B. Slawson, secretary.

Associations officially represented are: Southern California Professional Engineers Association, San Francisco Area Group of Professional Employees, Sacramento Group of Professional Engineering Employees, Engineers Guild of Oregon, Seattle Professional Engineering Employees Association, Professional Engineering Employees Association of Eastern Washington and the Southwest Washington Association of Professional Employees.

Persons desiring further information regarding this organization may contact Donald B. Slawson, secretary, 2135 N.E. 45th Ave., Portland 13, Ore.

Electric contractors ok union pension

An employees benefit agreement, providing for employer contributions to an industry-wide pension fund for electrical workers was signed formally in Washington last week by officials of the International Brotherhood of Electrical Workers and the National Electrical Contractors Association.

The plan will go into operation soon after the Treasury Department's expected approval of the employers' payroll contribution as a deductible item of cost for tax purposes. The program affects 2,000 electrical contractors in all parts of the country, and 100,000 members of IBEW, a majority of whom are in the construction field.

Union men covered under the pension fund contribute 60 cents a month to the fund, and this sum is to be matched dollar for dollar by the employers' contributions. The fund will provide a retirement benefit of $50 per month to members of the IBEW when they reach 65 years of age, after 20 years of continuous membership.

The agreement was hailed as the first industry-wide pension agreement in the construction field, where workers traditionally are only intermittent employees of any one contractor. It provides for administration through a board of trustees known as the National Employees Benefit Board for the Electrical Contracting Industry. This board will consist of 15 members, seven appointed by NECA, seven by IBEW, and one by the Secretary of Labor. None of the members will receive compensation. Basis of the pension plan is a payroll adjustment in an amount equal to one percent of the gross labor payroll of electrical contractors paid to members of IBEW. This sum is to be collected locally from each contractor, and the board will make quarterly payments to the pension benefit fund.

The union has had a pension system for about 18 years, but due to the increase in membership, the longevity of its members and other causes, it has been unable to stabilize the benefit fund.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction—The Coosá River Paper Co. announced plans for an $18,000,000 newsprint mill at *Childersburg, Ala.* . . . A Delaware state welfare center will be built on the site of Fort DuPont, near *Delaware City, Del.* . . . Building of a $400,000 concrete structure to house Harvard University's new cyclotron has begun. . . . CPA has approved application of the American Anka Corp., Asheville, N. C., to construct a synthetic yarn plant at *Morristown, Tenn.*, with initial expenditure of $7,430,000. . . . FWA has approved an advance of $33,000 to finance plans and specifications for a $2,500,000 expansion of port terminal facilities for *Pensacola, Fla.* . . . Two $1,000,000 buildings are planned for *Portland, Ore.*, by the Bank of California and Fibreboard Products, Inc. . . . A $2,000,000 flour mill is planned at *Alton, Ill.*

Housing—The John A. Roebling's Sons Co. has offered the entire town of *Roebling, N. J.* for sale, including 700 houses. President Charles R. Tyson said funds realized from the sale would be used in a several million dollar expansion program now being planned. . . . About 4,500 housing units are being erected in the 5-county district around *Kansas City, Mo.* . . . A recent consumer analysis survey shows that more than half the homes in the metropolitan area of *Indianapolis, Ind.* are in need of major repairs and replacements. . . . The War Assets Administration announced Oct. 7 that virtually all of the government's war surplus building materials and equipment will be made available for veterans' housing within 60 days.

Highways—The *Chattanooga, Tenn.*, city commission voted to approximate $265,000 to acquire rights-of-way for widening Rossville Boulevard. . . . The *Wisconsin* State Highway Commission is considering relocation of Highway 41 between *Milwaukee* and *Fond du Lac.* The work would cost over $10,000,000. The *Milwaukee County* highway committee has under consideration a 10-year improvement program to cost about $55,000,000. . . . The North Carolina state advisory budget committee has asked for over $50,000,000 for 1947-48 for state highways and public works.

WAB begins publishing legal area wage rates

Publication of legal area wage rates for mechanics and laborers in the building and construction industry on a county-by-county and craft-by-craft basis was started Sept. 27 by the Wage Adjustment Board, which administers the wage stabilization program for the building and construction industry.

Rates for three states were listed in the *Federal Register* of Friday, Sept. 27, in accordance with recently announced program to compile and publish the rates as determined by WAB.

Regulations permit contractors and other employers of building mechanics in on-the-site jobs to pay the established area rate, as published, without the necessity of filing applications for the specific approval of WAB. Once adopted by a contractor, no area or other approved rate may be reduced without approval of the agency. Where no area rates exists, any contractor or labor representative may apply to the board for establishment of a rate.

Pending completion of the nationwide compilation of area rates, information on unpublished rates may be obtained from many of the Regional Wage Stabilization Boards, or the Wage Adjustment Board, Department of Labor Building, Washington, D. C.

First lists to appear in the Federal Register were those for the states of Nevada, New Mexico, and Utah, in which relatively uniform scales prevail. Lists of rates for other states will be published from time to time.

CAA sets up offices for airport program

A list of regional and district offices through which the Civil Aeronautics Administration will carry out the billion-dollar airport program approved during the last session of Congress (*ENR* May 16, vol. p. 763) was made public at Washington last week.

The bill provides $500,000,000 of federal aid to state and local groups for airport construction during the next seven years.

Regional office addresses listed by CAA are:

Region 1, Superintendent of Airports, 385 Madison Ave., New York 17, N. Y.; Region 2, Superintendent of Airports, 84 Marietta St., NW, Atlanta 3, Ga.; Region 3, Superintendent of Airports, Room 1017-A Insurance Exchange Building, 166 W. Van Buren St., Chicago, Ill. Region 4, Superintendent of Airports, P. O. Box 1689, Forth Worth, 1, Tex.; Region 5, Superintendent of Airports, City Hall Building, Kansas City 6, Mo.; Region 6, Superintendent of Airports, 1500 Fourth St., Santa Monica, Calif.; Region 7, Superintendent of Airports, CAA Building, Boeing Field, Seattle 14, Wash.; Region 8, Superintendent of Airports, CAA, Anchorage, Alaska, and Region 9, Superintendent of Airports, CAA, P. O. Box 4009, Honolulu 12, Territory of Hawaii.

Under the jurisdiction of these regional offices are a number of district offices located for the most part in principal cities in the region.

Sewerage—Washington State Pollution Control Commission has approved plans and specifications for sewer projects in 15 cities—*Bremerton, Coulee City, East Wenatchee, Ellensburg, Grand Coulee, Kent, Leavenworth, Lind, Manson, Omak, Pullman, Quincy, Seattle, Soap Lake* and *Renton*. . . . Preliminary and final plans for sewage works to cost $6,000,000 have been approved by the *Indiana* Stream Pollution Board. . . . B. V. BeVier, assistant engineer for the Ohio Health Department, says that of 500 *Ohio* communities using river or lake facilities for disposal, only half have sewage disposal plants, and the remaining 250 have been asked to prepare detailed plans for construction.

Bond Issues—*East Moline, Ill.*, recently defeated a $1,600,000 bond issue for proposed water and sewer mains, filtration and sewerage disposal plant. . . . On Nov. 5 *Manhattan, Kan.*, will vote on an $800,000 bond issue for a city auditorium. . . . *Cottage Grove, Ore.*, has approved a $300,000 water bond issue to build a 22-mile supply line. . . . *Olympia, Wash.*, will vote Nov. 5 on a $500,000 bond issue to finance construction of two elementary schools. . . . *Martinez, Calif.*, residents have approved an additional bond issue of $140,000 to build a city-owned water filtration plant. . . . The Board of Education of *Valdosta, Ga.*, will seek a $400,000 bond election for additional buildings and improvements to the educational facilities. . . . Only 1,700 of some 60,000 *Ogden, Utah* residents turned out in a recent $1,025,000 bond election, but they defeated seven municipal construction proposals by a majority averaging 65 percent.

Water Supply—The issuance of $225,000 in municipal bonds has been authorized at *Salisbury, N. C.*, for expansion of the city water system during the next 12 months. . . . Work has started on the laying of a water main from the Upper Seymour intake to the Second Narrows at *Vancouver, B. C.*

Sanitary men urge concerted action to solve stream pollution problems

Joint American-Canadian meeting hears discussion of many phases of stream-clearing, other sewage disposal matters

The need for concerted action by all concerned to obtain legislation and technical development for effective control of stream pollution was evident last week as U. S. and Canadian sanitary men held a three-day meeting at Toronto, Ont.

Evidence of the intense interest in this problem was the record attendance of 812 at the first postwar session of the Federation of Sewage Works Associations, held jointly with the annual convention of the Canadian Institute on Sewage and Sanitation.

The papers presented emphasized the complexity of the stream-clearing drive now current in both countries, and suggested remedial measures for some of the more important phases of pollution abatement and control.

H. W. Streeter, sanitary engineer, U. S. Public Health Service, Cincinnati, Ohio, told the group that stream sanitation standards should be brought "within the purview of scientific investigation, rather than that of conflicting opinion, if such standards are to accomplish their ultimate purposes." He pointed out the present lack of standard data and exchange of pertinent information as in need of correction.

Discussion of this paper brought out the fact that in the opinion of the delegates no standard of stream or water sanitation, of and by itself, can accomplish a great deal. Speakers said that without correlated restrictions upon individual contributing sources of pollution the standard becomes a desirable, but unattained, objective. Much of the discussion also centered on the need for caution in legislative action, lest impossible restrictions be imposed on industry or municipalities.

Control at the source

Toronto's peculiar problems in sewage disposal, and construction now under way to alleviate those problems (*ENR* Oct. 3, vol. p. 439), were outlined by William Storrie, consulting engineer on the project. He placed particular emphasis on the need for immediate development of the new plant as a complete treatment unit, although present municipal plans call for completion over a period of years.

Discussion of industrial phases of stream pollution abatement were highlighted by H. G. Joseph of the Ontario Paper Co., who detailed methods of recovery of industrial alcohol from the company's sulphite waste liquors.

These wastes, of which some 270,000 gpd. are presently processed to yield about 2,500 gpd. of alcohol, were formerly dumped untreated into the streams. The high degree of pollution eliminated can be realized, Mr. Joseph said, from the fact that waste being treated contains an average of 12 percent solids and two percent sugars, as well as dissolved sulphites, and other materials of high bio-chemical oxygen demand.

Mr. Joseph estimated that over 31.5 mg. of ethyl alcohol could be produced from the half-million tons of pulp sugars annually wasted by Canadian mills, and that the U. S. figure would be 36 mg. annually.

Other papers on industrial problems included a discussion of the characteristics and methods for treatment of de-inking process wastes, and a hypochlorite process for treatment of wool-scouring wastes.

Features of the 3-day program were a symposium on sludge disposal and a round table discussion on operating problems, as well as papers on "Financing Sewage Systems" by Francis S. Friel, consulting engineer of Philadelphia, Pa., and a digest of the National Research Council subcommittee's report on the Army sewage treatment program, presented by Harold A. Thomas, Jr., assistant professor of sanitary engineering, Harvard University. Digests of Mr. Friel's paper and the subcommittee's report, will appear in an early issue of this journal.

New officers

As part of manufacturers' activities at the joint meeting, Albert E. Paxton, publisher of *Engineering News-Record* and *Construction Methods*, was elected president of the Water and Sewage Works Manufacturers' Association. D. Saunders, of the Permutit Co., New York City, was elected vice-president.

New FSWA officers seated at the convention were: Francis S. Friel, president; George S. Russell, consulting engineer, St. Louis, Mo., vice-president; W. W. DeBerard, city engineer, Chicago, Ill., reelected treasurer, and A. F. Dappert, of the New York State Department of Health, director-at-large.

W. J. Orchard, general manager, Wallace and Tiernan Co., Newark, N. J., was elected an honorary member.

Canadian Institute officers are: Harold S. Nicklin, city engineer, Guelph, Ont., president; Dr. Albert E. Berry, director of the Sanitary Engineering Division, Ontario Department of Health, secretary-treasurer; and Nicol MacNicol, commissioner of works, Forest Hill, Ont., vice-president.

Engineering and Contract Record (Canada) photo

***Sewage Works Leaders**—Officers of American and Canadian sewage works associations pose for a group portrait at joint meeting of the Federation of Sewage Works Associations and the Canadian Institute on Sewage and Sanitation. Seated, left, is Harold S. Nicklin, president of CISS, and Adm. J. K. Hoskins, assistant surgeon general, U. S. Public Health Service, retiring FSWA president. Standing, left to right, are: Nicol MacNicol, vice-president, CISS; Francis S. Friel, Philadelphia, Pa., new FSWA president; W. H. Wisely, executive secretary, FSWA and Albert E. Berry, secretary-treasurer, CISS.*

Army camp material makes homes for veterans

A San Diego, Calif., venture into housing—the purchase of a military camp early this year for $200,000 to obtain building materials for veterans' homes—has proved successful both financially and from the standpoint of homes provided, City Purchasing Agent J. H. Shaw reports.

Camp Callan, now stripped of its 650 buildings, has provided residential dwellings for 1,500 GI's, who paid $1,200 apiece for sufficient material to build a home.

Vets and their wives carefully dismantled the large buildings and carted lumber away. Smaller buildings were cut into sections and moved bodily from the site to new building locations.

City officials are well pleased with the transaction, which yielded more living units than were expected and turned a profit for the municipality. The $170,000 over the purchase price received will go toward restoration of the area to its prewar use as a park.

Georgia Army camp sold

Bids totaling more than $460,000 have been received by the South Atlantic Division, Corps of Engineers, Atlanta, Ga., from the 49 high bidders for the 1080 buildings located at Camp Wheeler, near Macon, Ga. A total of 120 bids from all parts of the country were received.

It is expected that when awards are made the government will realize close to $500,000 for the buildings and the sanitation, water and heat facilities therein. The total cost of the buildings and equipment was $10,500,000. The District Engineer pointed out that the bids were in excess of estimated salvage value.

SEATS FOR SUPERINTENDENTS

Latest construction innovations for the benefit of "sidewalk superintendents" is a pavillion set up at Broad and Spring Garden Sts. in downtown Philadelphia, Pa., where McCloskey & Co., contractors, are building a $2,000,000 rotogravure building for The Philadelphia Inquirer.

Spectators enter through a special door to the pavillion, which is provided with seats, and get a good view of the construction operations. Supplementing the scene before them, visitors can listen to hourly news broadcasts over a radio loudspeaker installed in the pavillion and enjoy other regular program entertainment features.

Attendance has been amazing.

Ft. Wayne VA hospital to cost $3,500,000

Preparation of plans and specifications for a $3,500,000 veterans hospital on a 26-acre site at Fort Wayne, Ind., is to be initiated at once, according to Col. A. Riani, district engineer for the Corps of Engineers at Detroit, Mich.

An architect-engineer contract has been awarded to Giffels & Vallet, Inc., of Detroit, for preparation of complete plans and specifications. A. M. Strauss, architect, of Fort Wayne, is to be associated with them. The hospital is to be a 200-bed general medical unit, complete with all appurtenances such as power house, laundry, and resident quarters for nurses and internes.

Univ. of Kentucky wants $10 million for buildings

President H. L. Donovan of the University of Kentucky said last week he will ask the next Kentucky legislature for $10,000,000 for construction of dormitories, classrooms, and laboratories.

With enrollment still in progress, almost 6,500 students have been registered, exceeding expectations by 1,000 and taxing to the limit the institution's facilities.

Idaho Power Co. to build 3 hydroelectric plants

As part of the largest development program in Idaho Power Co.'s history, three new hydroelectric generating plants are planned for immediate construction on the Snake and Malad Rivers, B. C. Russell, general superintendent, has announced.

All three installations will complete existing generating facilities at river sites now in use.

Final plans would call for expenditure of approximately $11,950,000 to provide additional generating capacity of 68,550 kw. Contracts have been let to Morrison-Knudsen Co., Inc., Boise, for the construction, which probably will last until late 1948.

The largest of the three projects is the rebuilding of the dam and power plant at the Lower Salmon site on the Snake River near Hagerman. The existing installation, which was constructed by a predecessor company in 1910 and which is rated at 7,200 kw. capacity, will be replaced by units having an installed capacity of 60,000 kw.

The new Upper Malad plant will generate 7,250 kw. and the Lower Malad, 13,500.

Many road improvements urged at Pittsburgh

Top highway projects recommended in a recent report of the Conference on Community Development at Pittsburgh, Pa., are as follows:

Construction of North Boulevard to connect Ohio River Boulevard with eastern East Ohio Street, by-passing North Side business district, relocating U. S. 19 over East Street and McKnight Road, and building a high level bridge over Allegheny River to East Street.

Regarding Neville Island bridge, the report suggests selecting a site, acquiring property and overhead rights for a bridge connecting Ohio River Boulevard with Neville Road. The bridge also would reduce the roundabout route between North Boroughs area south to industrial plants on the island.

The report suggests that Pittsburgh's 63-year-old one-lane Smithfield Street bridge be acquired by Allegheny County, which should construct a new bridge. Also that Penn Boulevard connect Allegheny River Boulevard with Wm. Penn Highway.

Approve tri-city work

Plans for a $4,251,000 tri-municipal highway improvement program including the construction of a new $2,321,800 highway and rail bridge across the Monongahela River between McKeesport and Dravosburg, Pa., have been approved by the Pennsylvania Public Utility Commission. In addition to two approaches, the project includes two new ramp highways, widening of approach avenues, and removal of an existing structure.

The river bridge, to be 1931 ft. in length, at high level, will consist of a cantilever structure having a channel span 500 ft. in length and two anchor spans each about 201 ft. long.

THIEVES SOLVE NAIL SHORTAGE

According to the Montreal, Canada, *Gazette*, local construction men report that a group of thieves have made their own solution to the problem of making quick profits out of the shortage of building nails.

The newspaper said a gang of thieves robbed a construction shanty, garnering ten kegs of nails. The next day, the thieves approached another construction outfit and offered to sell the nails at $50 a keg.

The price was high, but nails are scarce. The deal was made and the nails delivered.

The very same night, the new buyer was robbed—of ten kegs of nails.

Cut non-residential building further to spur lagging housing program

Amend housing order to reduce exemption of small jobs—New orders issued to channel more materials to housing

The Civilian Production Administration Oct. 7 amended its controls on construction to further curtail non-residential work. The CPA and National Housing Agency also jointly announced new subsidies for critical items and the extension of the priority assistance for obtaining housing supplies, while NHA reported another contract for a guaranteed market for factory-built, moderately priced houses.

Meanwhile, the construction division of the Department of Commerce reports that of the $1,060,000,000 of new construction put in place in September, residential construction amounted to $385,000,000 with privately financed housing jumping to 379 percent over a year ago.

The further curtailment of non-residential projects considered unessential at this time has been accomplished by severely amending the CPA Veterans Housing Program Order No. 1. This has been done by making major changes to those parts of the order pertaining to small jobs that have been exempt because their total cost was below certain ceilings. The amended order also imposes new controls on the construction of swimming pools, boardwalks, amusement park devices, and concrete surfaces or bases for drive-in theaters, parking lots and tennis courts. The erection of a wall or fence built primarily of wood, brick, concrete or concrete blocks also is restricted and CPA approval for such work must be obtained.

The older small job allowances (*ENR* Mar. 25, vol. p. 441)—$400 per job for a house, $1,000 per job for a store, $15,000 per job for a factory, and $200 per job for a billboard or tourist cabin—were intended to make it unnecessary for owners to apply for permission to do comparatively minor alteration or repair jobs. While the $15,000 small job allowance still is considered appropriate for a large factory, experience has shown that for small buildings, the $15,000 constituted a complete exemption rather than a small job allowance for routine alteration jobs. The $15,000 "small job allowance" provision for work on industrial, utility and transportation buildings has been amended to restrict this allowance to buildings having a floor area of 10,000 sq. ft. or more. Smaller buildings of these kinds now have a $1,000 small job allowance.

Construction may proceed on structures of the kinds now curtailed by the amended order (including small industrial buildings and swimming pools) provided actual work had started and was being carried on at the time of the issuance of the amendments.

The new action was said to be necessary because substantial amounts of scarce materials were being used in exempted construction. For example, cement, which is required in large amounts for such projects as swimming pools, was not generally scarce on March 26 or at the time Order VHP-1 was issued (*ENR* April 4, vol. p. 459) but has now become sufficiently critical in some localities that lack of it is holding up residential construction.

Additional priorities

To further aid in channeling materials into housing, on Oct. 7 CPA and NHA placed under priority distribution six more groups of materials home builders are now finding in short supply. Authorized housing contractors are now able to use the HH priority rating to obtain furnace pipes, fittings and ducts; copper tubing fittings; building papers and sheathing papers; galvanized sheet steel, and certain types of electrical service entrance equipment. This new assistance has been made possible by amendment of Schedule A to CPA priorities regulation 33. With the new amendments, which include major changes in the definitions and terms of the order, a total of 66 groups of materials are now under priority distribution.

The two agencies have also announced that a premium payment plan to increase the output of wire nails is being completed and that the details will be announced in a few days. The proposed plan is a payment of $20 a ton for output in excess of stipulated quotas. The most recent figures for nail production reveal that the output for August was 65,000 tons or far greater than a year ago.

In working out new export quotas for building materials for the fourth-quarter of this year the CPA has limited the export of these materials to amounts varying from zero to not over 6 percent of the expected total production. The average allowable export is about four percent of total U. S. output.

Guaranteed market program

As a further aid to the veterans housing program the NHA has directed the Reconstruction Finance Corporato enter into a contract with the William H. Harman Corp., Philadelphia, for a guaranteed market for production of 10,000 factory-built moderately priced steel houses. This directive is the second of its type issued within a week. The first calls for production of 19,400 factory-built plywood houses by the Homeola Corp. Chicago (*ENR* Oct. 10, vol. p. 483).

Eight types of houses will be built by Harman, divided almost equally between two- and three-bedroom homes. The f.o.b. factory prices for two-bedroom models will range from $2,925 to $2,965; for the three-bedroom, from $3,352.50 to $3,672. The price of a house as it leaves the factory will be about half the cost of a complete home ready for occupancy. The NHA's technical office has estimated that the cost of a Harman house, erected and fully equipped, and including $1,000 for the price of a lot or land, will range from approximately $6,000 to $7,500, depending on whether it is a two- or three-bedroom type.

Veterans' housing plan starts in New Jersey

New Jerney's $41,000,000 veterans' housing program became effective Oct. 1, when Gov. Walter E. Edge signed a measure passed by the legislature which appropriated $6,000,000 to begin operations immediately. It also provided for a voters' referendum at the general election next month on a $35,000,000 bond issue for construction of housing.

Available accommodations of any sort, including ships, will be sought either for conversion or materials. Federal housing authorities will be solicited for all vacant military housing units that can be set up in New Jersey.

Home construction cost mounts to $7,000 average

The average construction cost (exclusive of land) of some 7,179 one-family privately-financed homes started in June in 27 industrial areas is expected to total $7,080 per unit, according to data released last week by the Bureau of Labor Statistics.

These data show that contractors expect to complete only 64 percent of the one-family units within six months after actual start of work.

Construction costs for single-family structures vary from a top figure of $11,040 in the New York City area to $4,300 at Fort Worth, Tex.

ENGINEERING SCHOOL NEWS

Lehigh inducts President Whitaker—M. I. T. receives $2,000,000 gift for a library—New sanitary laboratory at Johns Hopkins

Martin Dewey Whitaker will be inaugurated as the eighth president of Lehigh University, Bethlehem, Pa., Sunday, Oct. 20.

M. D. Whitaker

Dr. Whitaker, who is 44 years old, is recognized as one of the foremost authorities in the country on nuclear physics and was closely associated with the atomic energy program from its inception. He was director of the Clinton Laboratories at Oak Ridge, Tenn.

A native of Ellenboro, N. C., Doctor Whitaker received an A. B. degree from Wake Forest College in 1927, and an M. S. degree in physics from the University of North Carolina in 1930. After teaching physics there he attended New York University where he received a Ph. D. in 1935. He was acting chairman of the department of physics at New York University when in January, 1942, he joined the metallurgical laboratory at the University of Chicago to work on the program leading to the development of the first atomic bomb.

Following a year's research work at the university on the fundamental principles of the release of atomic energy, he was appointed director of the Clinton Laboratories to direct the design, construction and operation of the project, which became the principal facility for the research, development and pilot plant operation of the plutonium production process.

The Massachusetts Institute of Technology has received a gift of $2,000,000 from the Charles Hayden Foundation for the construction of a library building which is expected to set a new standard in university library design.

The new building will be a memorial to Mr. Hayden, a member of the class of 1890. It will face the Charles River basin on a site between the main educational buildings and the Walker Memorial. The gift came through the generosity of Mr. Hayden's brother, J. Willard Hayden, and the co-trustees of the foundation. Construction will be started as soon as government permission can be obtained.

The concept of the library and of an enlarged library program resulted from intensive studies begun by the corporation's visiting committee headed by Harlow Shapley. The institute also participated in an inter-university study of library construction carried on under a Rockefeller Foundation grant.

The school of engineering at Johns Hopkins University, Baltimore, Md., has expanded its department of sanitary engineering to include a new sanitary laboratory for graduate study and research. The laboratory is designed to carry on chemical, bacteriological and biological investigations of water supplies, sewage disposal, industrial waste treatment, stream pollution abatement and water resources development. Fundamental scientific explorations that may be used by public health administrators will be conducted in the new unit under the supervision of Charles E. Renn, formerly of Harvard University.

Milwaukee engineers dedicate new home

A cooperative community campaign strongly supported by 118 local industrial contributors culminated Sept. 21 in dedication by the Engineers' Society of Milwaukee of a permanent building to house its activities. More than 1,600 gathered at a banquet in the Milwaukee Auditorium to do honor to the society and to all engineers.

Eight local engineer groups, including the Wisconsin Section of the ASCE, are affiliated with the Milwaukee society. Acquisition of a permanent home was aided by sale to the society at less than market price of the former Fred Pabst residence at 3112 West Highland Boulevard. The spacious house has been remodeled to accommodate three meeting rooms with a seating capacity of 100 each, two dining rooms, a library, committee rooms and the society's general office.

Delivering the principal address at the banquet, on "The Challenge and Opportunities of Tomorrow," was Charles F. Kettering, vice president in charge of research, General Motors Corporation.

Olympia, Wash., seeks bids on a water supply project

Olympia, Wash., is readvertising for bids on the McAllister Springs Water Supply project, breaking the job into four parts in an effort to get bids under a $1,500,000 ordinance limit.

The city commission rejected a $1,574,521 bid by Morrison-Knudsen, Seattle, in mid-September. Under the new plan contractors may bid for one or more of the units, a pumping station, reservoir, and pipe line.

Road builders schedule meeting on machinery

Highway engineers, manufacturers of roadbuilding equipment, and highway contractors will hold a 2-day conference on the development of construction equipment at the Willard Hotel, Washington, D. C., Oct. 23-24.

Sponsored by a joint committee of the American Road Builders Association and the Highway Research Board, the sessions will be devoted to an attempt to reach agreement between builders' requirements and manufacturers' planning and schedules.

Group chairmen will include Charles W. Allen, George H. Dent and Kenneth B. Woods, who will guide discussions.

Pasadena residents fight Los Angeles smoke

The Los Angeles industrial area was the subject of bitter criticism at a board of city directors meeting attended by more than 1,000 Pasadena, Calif., residents Oct. 1.

The meeting was the result of a call by George L. Schuler, former Pasadena city director, asking citizens to go on record against the smoke and fumes that have plagued the area for several years.

Schuler demanded that some action be taken immediately to abate the nuisance. He charged that city, county and state health departments have not revealed the gravity of the situation.

After hearing the complaints, Chairman Robert E. Dawson of the board expressed the opinion that the matter can best be handled by state action. He said that A. I. Stewart, Pasadena's representative in the assembly, would introduce a bill in the next legislative session to abate the smoke nuisance.

Mayors, members of city councils and chambers of commerce in Alhambra, Monrovia, Azusa, Sierra Madre, Monterey Park, South Pasadena, San Marino, Arcadia, Temple City, San Gabriel, La Canada and El Monte have pledged the support of their communities in taking effective action to locate and eliminate the cause of offensive fumes in the San Gabriel valley.

OBITUARY

George D. D. Kirkpatrick, 67, since 1913 district cadastral engineer for the U. S. General Land and Public Survey office, died Sept. 29 in Salt Lake City, Utah. He was graduated from George Washington University with a civil engineering degree in 1902. He was appointed to the land office in 1904 and was assigned as a member of the survey charged with running the international boundary between New Mexico and Mexico.

Roland H. Barnes, 76, civil engineer, died at Newton Highlands, Mass., Oct. 4. He was graduated from Massachusetts Institute of Technology, 1891, and for many years was employed in Mexico and the Southwest. For more than 40 years he practiced his profession in Boston and retired two years ago.

Alfred Rutgers Whitney, 78, retired New York construction engineer, died Oct. 7. He was graduated from the Stevens Institute of Technology in 1890. At one time he was construction engineer with the Pudget Sound Pulp and Paper Co. and in 1894 represented the Carnegie Steel Co. in Japan. He later formed the Whitney Company and built many important buildings including the Amherst College library.

Robert M. Bennell, 61, city engineer, Moline, Ill., for the past 25 years, died Oct. 4.

Lawrence A. Beach, 45, right-of-way engineer for the Newark, Ohio, office of the Ohio Power Co., died Sept. 25 in Bucyrus.

Grover Cleveland Travis, 56, Belmont County, Ohio, engineer, serving his second term in that post, died Oct. 1 in Martins Ferry, Ohio.

Roy A. Paul, an engineer associated with many important construction projects in Canada, died Oct. 4 at Toronto. He was a graduate of the University of Toronto and during the last 12 years was construction manager for Pigott Construction Co., Ltd., Hamilton, Ont.

A. Elton Holcomb, 68, a 1901 civil engineering graduate of the University of Michigan and former sales manager of the shovel and crane division of the Koehring Co., Milwaukee, Wis., died Oct. 5 at Indianapolis, Ind. He had retired three years ago.

William F. Kellermann, 46, who had been with the Public Roads Administration since 1920, died in Washington, D. C., Oct. 10. His most recent assignment was that of senior materials engineer in the Washington headquarters office of Division 2. Before joining the PRA Mr. Kellermann worked in Washington for two and a half years with the Bureau of Standards. In 1926 he received a B. A. in civil engineering from the University of Maryland.

George H. Duggan, 85, chairman of the Dominion Bridge Co. and an engineer responsible for many major structures in Canada, was killed in a highway accident at St. Jerome, Que., Oct. 8.

Calendar of Meetings

NATIONAL

Associated General Contractors of America, Inc., fall meeting, Benjamin Franklin Hotel, Philadelphia, Pa., Oct. 21-22.

Structural Clay Products Institute, annual meeting, Hotel Roosevelt, New Orleans, La., Oct. 23-25.

National Council of State Boards of Engineering Examiners, 25th annual meeting, Hotel Statler, St. Louis, Mo., Oct. 27-29.

American Institute of Steel Construction, annual convention, Del Coronado Hotel, Coronado, Calif., Oct. 28-31.

American Public Health Association, 74th annual meeting, Cleveland, Ohio, Nov. 11-15.

American Welding Society, annual meeting in conjunction with the National Metal Congress and Exposition, Atlantic City, N. J., Nov. 17-22.

REGIONAL

American Water Works Association, Missouri Section (organization meeting), Hotel Daniel Boone, Columbia, Mo., Oct. 21-22.

American Water Works Association, California Section, Whitcomb Hotel and Civic Auditorium, San Francisco, Calif., Oct. 23-25.

American Water Works Association, Kentucky-Tennessee Section, Andrew Johnson Hotel, Knoxville, Tenn., Oct. 28-30.

American Water Works Association, Iowa Section, first reorganization meeting, Hotel Kirkwood, Des Moines, Iowa, Nov. 4-6.

American Water Works Association, New Jersey Section, Chelsea Hotel, Atlantic City, N. J., Nov. 7-19.

The Associated General Contractors of America, Inc., Carolinas Branch 26th annual convention, Sheraton Bon Air Hotel, Augusta, Ga., Nov. 10-12.

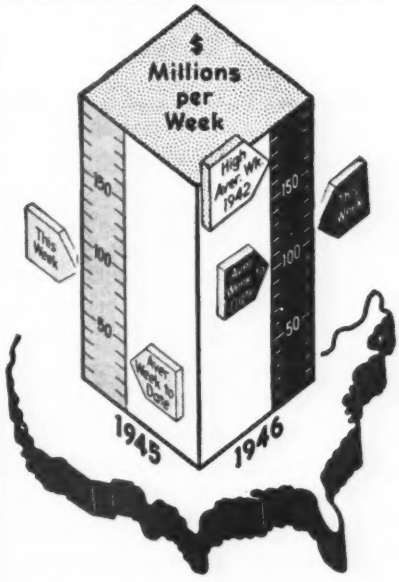
Southeastern Association of State Highway Officials, annual meeting, Tutwiler Hotel, Birmingham, Ala., Nov. 12-13.

American Water Works Association, Virginia Section, John Marshall Hotel, Richmond, Va., Nov. 14-15.

American Water Works Association, Wisconsin Section, Northland Hotel, Green Bay, Wis., Nov. 15-17.

American Water Works Association, North Carolina Section, Hotel Caroline, Raleigh, N. C., Nov. 18-20.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Oct. 17 1946	Cumulative 1946 (42 wks.)	Cumulative 1945 (42 wks.)
Federal	$1,830	$553,321	$687,581
State & Mun.	26,160	1,182,034	288,542
Total Public.	$27,990	$1,735,355	$976,123
Total Private	80,215	2,671,675	701,149
U. S. Total..	**$108,205**	**$4,407,030**	**$1,677,272**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (42 wks.)	Cumulative 1945 (42 wks.)
Waterworks	$2,043	$93,085	$42,380
Sewerage	2,378	92,541	27,818
Bridges	825	108,918	32,364
Highways	11,442	645,663	182,261
Earthwork, Waterways	864	315,936	43,901
Buildings, Public	1,503	337,551	420,342
Industrial	49,257	891,495	422,948
Commercial ...	27,982	1,606,862	186,266
Unclassified	11,911	314,979	318,333

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (42 wks.)	Cumulative 1945 (42 wks.)
NON-FEDERAL	$1,256,721	$651,779
Corporate Securities	357,347	163,231
State and Municipal	674,374	324,948
RFC Loans	.....	24,600
REA Loans	.....	60,000
Fed. Aid Highway	225,000	79,000
FEDERAL	1,672,982	1,049,898
Total Capital.....	$2,929,703	$1,701,677

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost...	Oct. '46	360.94	173.50
Building Cost.....	Oct. '46	272.74	147.43
Volume	Sept. '46	223	98

EDITORIALS

VOLUME 137 NUMBER 16

October 17, 1946

Toward Better Buildings

THAT BETTER BUILDINGS can be built without increasing costs is the theme of a special section in this issue entitled "Toward Better Building". Such improvement can be brought about by taking advantage of the latest engineering data revealed through research or by experience and through use of the newest materials and techniques that have been proved practicable. If the construction industry is to prosper soundly, more rather than less for every building dollar is a necessary goal. Helpful suggestions to this end are contained in the articles in the special section. For example, the principles of flexibility of layout outlined for the design of industrial laboratories, if applied to other types of buildings, could extend by many years the usefulness of those structures to their owners. Also, as shown for walls and roofs, it may be more economical to use construction methods with a relatively high first cost if maintenance is reduced. In many cases, initial savings may be made through economical designs without sacrificing desirable features, as is demonstrated in the case of concrete "slab-band" floors. Further economies may be possible through the use of new materials, whose development is now being encouraged by the government in promoting the housing program. These may not only cost less and serve better than traditional materials, but also may minimize problems arising from shortages. In addition, the stimulation of panel construction, leading to new or improved methods of erection, may cut costs even more. The opportunities offered in improved designs, faster erection and in the use of new materials are challenging. Wisely grasped, they can assure better buildings at lower costs.

Cooperative Sanitation Progress

IN THE PREAMBLE of the constitution of the newly-formed Inter-American Association of Sanitary Engineering, which was approved at Caracas, Venezuela, on Oct. 2, it is stated that "An association of engineers created by themselves as individuals on the basis of common interest and operating in a democratic manner can better accomplish this [cooperation] than delegates appointed by the various governments." Everyone must applaud this statement of independence on the part of professional men, yet it is questionable whether the association can enjoy all of the freedom of action that it desires, since the constitution requires that the general secretary be selected by the Pan-American Sanitary Bureau, a treaty agency representing the 21 American republics, and thus subject to protocol. Furthermore, the bureau eventually will become subsidiary to the World Health Organization, and this can mean even greater restriction of the independence of action sought by the association of sanitary engineers. Although the Pan-American Sanitary Bureau has been most useful and cooperative in supplying financial and other aid toward the establishment of the association as an operating group, it is hoped that an early opportunity will present itself for the association to cut free from any and all governmental control. If it is principally a matter of financing, the laudable objectives of the Inter-American Association of Sanitary Engineering for the improvement of public health in the Americas should find ready support in any number of fund groups broadly interested in the betterment of social conditions.

Put Priorities Where They Count

UNLESS HOUSING is to bog down like meat, some drastic changes in governmental controls are immediately necessary. Release of meat from all controls, announced as this issue goes to press, gives new hope that construction may also be freed.

In these columns in the Oct. 3 issue the need for quick abandonment of price controls on building materials was urged to eliminate the black market, avert a buyer's strike and keep housing out of politics. Equally severe changes are required in the system of purchase priority controls for materials if we are to make the housing that actually gets under way effective.

Up to now, great emphasis has been placed on starting housing, but very little special aid has been accorded builders to turn their "starts" into "completions". Only about one half of the 464,000 conventional house and apartment units begun in the first eight months of the year were completed in that period, and the air is full of reports of unfinished houses that lack nails, plumbing, flooring, wiring or roofing. Instead of striving so mightily to reach the one-time goal of 1,200,000

starts this year, the housing authorities should devise some means of special priority aid that would result in quick completion of the houses already started. Pending removal of price controls, corollary action is required to move materials from areas of surplus to areas of scarcity, this mal-distribution being one of the principal present difficulties.

Some such change in thinking as outlined here is necessary if the housing program is to be rescued from the fate of meat, and it should be part of a broader plan for complete elimination of all controls as soon as possible. The present imbalance in construction, by which needed industrial and public-works construction is held back in favor of housing, is dangerous to the economy if continued too long. It is particularly dangerous if housing muffs its opportunities because of high costs and misdirected priorities.

A Creed for Bargaining

WHEN the Seattle Professional Engineering Employees Association was officially recognized as the collective-bargaining agency for the engineers of the Boeing Aircraft Co., Trygve Hoff, president of the association, set forth a bargaining policy for the association that warrants thoughtful study by all concerned with employee-employer relations in engineering work. Speaking to his associates through the pages of the *Northwest Professional Engineer*, Mr. Hoff said:

> We now have a new privilege, and with it a new responsibility. We, as a group, now have an interest in our job that we never had before—a sort of vested interest—a stake of considerable value which it behooves us to protect. We should seek not only an increased income, but we should determine to give value received, to cooperate to the very best of our ability, and to do our utmost to build up the earnings of the Boeing Company. We should make management less, not more, difficult and costly, and should strive to keep our relationship with management entirely free from unimportant demands and complaints. . . . Let us demonstrate that our increased productive power, due to our better morale and cooperation, will more than offset the cost of the increase in salaries that we are proposing, will help keep Boeing on a sound basis.

In making that statement, Mr. Hoff has set forth a policy that, if widely adopted, would eliminate one of the worse aspects of collective bargaining as commonly practiced today. The basic fault of bargaining as generally conducted rests in the almost universal assumption by union negotiators that the ability or lack of ability to pay higher wages is of no concern to the men they represent. This, in turn, has built up an unreasonable approach to bargaining on the part of most employers. As a consequence, negotiations have become a battle of wits, and what goes by the name of collective bargaining is more truly collective pressuring. Thus if engineers can put their collective bargaining on the higher plane visualized by Mr. Hoff, a great step forward will have been made.

It would be short sighted, however, to overlook the hard fact that adopting such a policy and making it fully effective are quite different operations. One unfortunate result of collective bargaining has been to level opportunities for advancement — those of the able men being reduced while those of the poor and mediocre workmen are improved. Also, the voices of malcontents, who generally are found among the poor workers, are amplified. Out of this condition have grown the trade union rules calling for advancement on the basis of seniority rather than skill, and restrictions on output.

Will experience be different in the associations of engineers that have been formed in the last few years in an effort to keep men with high ideals from being swallowed up in unions in which they have no voice? It well could be different because of the higher percentage of able men in the engineer bargaining groups. But success will call for wholehearted support for their leaders from the bulk of the men in those groups if standards such as Mr. Hoff has proposed are to be maintained.

Success also will depend in no small measure on the employers, especially on the heads of consulting firms or the engineering executives of large industrial concerns with whom the men must deal. If consultants are unwilling to pay the rank and file of their employees rates that compare favorably with those of the skilled mechanics on the job for which they are making designs, or if the heads of corporation engineering departments will not go to the top management seeking like compensation for the men under them, then no amount of idealism on the part of the leaders of the men will keep bargaining from slipping down to lower levels.

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Fig. 1. Large earthmoving units speed construction and provide compaction of sand subgrade for Nebraska highways.

Armor Coated Highway Construction Through the Sand Hills of Nebraska

***Contents in Brief**—Improved methods of construction and years of experience enable the Nebraska State Highway Department to construct a high-type bituminous pavement using native blow-sand found in the sand hills. Protected with an armor coat of special gravel, the pavement has many qualities superior to ordinary gravel roads yet in some instances its cost of construction is less.*

FACED with the necessity of providing all-weather roads through sand hill sections of Nebraska, far removed from deposits of clay and gravel, the state highway department has perfected a method of constructing an armor-coated, bituminous-sand pavement which has proved quite satisfactory. It is superior in riding quality, has a longer life expectancy, requires less maintenance and is frequently more economical of construction than the conventional type of unoiled, gravel-surfaced road with clay binder found on many secondary and low-type primary highways throughout the Middle West. Some 280 miles of this bituminous-sand pavement have been constructed in Nebraska since the first experimental section was installed in 1929.

Even on certain highways in the sand hills near adequate gravel deposits where the low-volume of traffic does not necessarily warrant an armor-coated pavement, the cost of transporting clay binder over long distances (20c. per cu.-yd.-mile) would make the cost of a graveled road exceed that of one constructed with native sand and bituminous binder.

A typical example of such a bituminous-sand surfaced highway is a 10½-mile length of new federal-aid highway now under contract between Greeley Center and Bartlett, Neb., by Peter Kiewit Sons' Co., Omaha, at a total cost of $18,970 per mile, which includes minor drainage structures and guardrail costing $1,450 per mile. When completed, the road will have a 5-in. thick bituminous-sand surfacing with a crown width of 27 ft. and measuring 29 ft. at the bottom of the pavement.

Compacted by tractor and scraper

In constructing the subgrade embankment of native blow-sand found in this region, experience has proved that better compaction is obtained, not with the usual sheepsfoot roller, but with tractor and medium-heavy rubber-tired earthmoving equipment. The vibration of such equipment, together with the kneading action of the pneumatic tires, literally shakes the sand into the required degree of compaction.

As would be expected, excavation of the sand is easy, providing due care is exercised not to cut so deep when loading a scraper as to mire the prime mover. And this can hap-

pen even with a crawler-type tractor, particularly just before the scraper is fully loaded.

Equipment used in excavation and embankment work on this job includes three 12 to 15 cu. yd.-scrapers, each pulled by a crawler-type tractor; two portable electric light plants with floodlights mounted on towers for night operations; one 500-gal. diesel fuel truck; a 1½-ton service truck equipped with an A-frame and hand-operated hoist; a portable welding machine; and two trailer houses, one equipped as a machine shop and greasing station, and the other serving as a field office.

Small but efficient crew

A nine-man crew working a total of five 8-hr. shifts per day (two tractor units each operating 16 hours and one 8 hours per day) place an average of 5,000 cu. yd. of embankment per day, under a contract price of 16c. per cu. yd. In general, one mile of embankment is built each way from the field headquarters, following which, a new camp site is selected and occupied two miles farther down the highway.

Careful control of materials and the adoption of proved construction methods are the secrets of obtaining a high-type bituminous-sand roadway surface in the sand hills of Nebraska such as the one being built north of Greeley Center. Materials include natural sand with mineral filler added as necessary, and a bituminous binder which usually is an MC-2, MC-3 or MC-4 cutback asphalt similar to that used in constructing oiled gravel roads.

The grade of asphalt oil for each project is determined by the highway department on the basis of job requirements and weather conditions prevailing at the time of construction. When a traveling mixing plant is used, however, the contractor has the option of using a special rapid-curing, soft-base, cutback asphalt. On this particular job such an oil, designated TMP-3, is being used.

An indication of the type of material with which asphalt pavements are constructed in the sand hill areas of Nebraska can be envisaged by the gradation of the blow-sand found on the project north of Greeley Center. An average of typical tests on this project, which is typical for many of the sand hill areas is as follows:

Sieve No.	*Total percent retained*
50	15
100	70
200	94

Whether the materials are mixed together by the blade-mix or traveling-plant-mix method, the first operation following completion of the subgrade is to add the proper amount of filler to the 6-in. surface course of sand to be oiled. Usually, sufficient filler is added to provide approximately 20 percent of material passing a 200-mesh screen in the combined sand and filler. On this particular job the design called for the filler material to be a very fine sand-clay with 60 to 80 percent passing a 200-mesh screen. Sand and filler are thoroughly mixed by scarifying.

In general, the bituminous-sand surface course is placed over one-half the width of road at one operation. The other half is needed for traffic. For blade-mix jobs, the asphalt is applied to the sand and filler with a pressure distributor, and thoroughly mixed with disk and blade grader. When a traveling plant mixer is used, it usually is equipped with a special adjustment to permit cutting to a depth slightly under 6 in., which gives a compacted bituminous mat measuring a full 5 in. in thickness.

Field test of combined mix

Frequent field tests insure the proper amount of bitumen being used in the bituminous mixture at all times. According to the state's specifications, the percentage of bitumen is determined by the formula:

$P = 0.02a + 0.04b + 0.06c + sd$ where,

P = percentage of bitumen required in the bituminous mixture prior to laying.

a = percentage of aggregate retained on the No. 50 sieve.

b = percentage of aggregate passing a No. 50 sieve and retained on a No. 100 sieve.

c = percentage of aggregate pass-

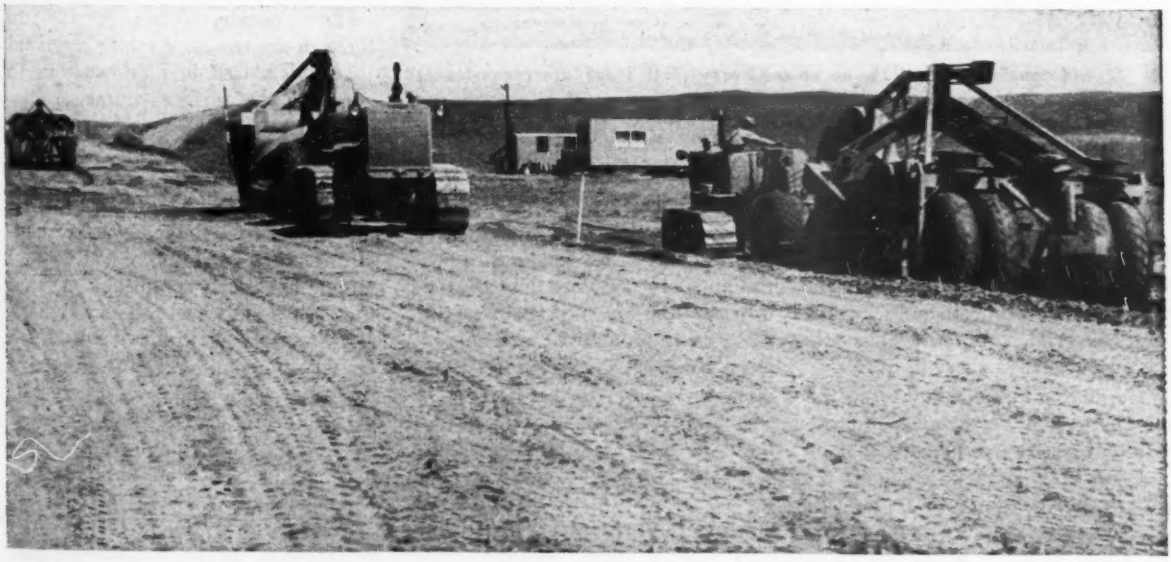


Fig. 2. Three earthmoving units place and compact 5,000 cu. yd. of embankment per day at a contract price of 16c. per cu. yd. Trailer houses (background) serve as field office and machine shop.

Fig. 3. Old county roads of the horse-and-buggy class (top) are reconstructed as first-class highways carrying an armor-coated pavement of bituminous sand (bottom), costing less than $20,000 per mile.

ing a No. 100 sieve and retained on a No. 200 sieve,

d = percentage of filler material in the combined aggregate.

s = a factor depending upon the fineness and absorptiveness of the filler material. All percentages in the formulas are by weight.

The above formula, however, was incorporated in the standard specifications when it was planned that no seal was to be applied. Actually, the current procedure is to reduce the bitumen content of the bituminous aggregate to about 80 or 85 percent of that indicated by the formula, since present designs provide for the immediate application of a seal and armor coat.

The Nebraska highway department has found that best results with penetration of the bitumen into the sand and filler are obtained if the mixture contains from 3 to 5 percent moisture. However, this moisture content must be reduced to less than 2 percent before compaction of the finished roadway. Consequently, the mixture is aerated and thoroughly mixed with tractor-operated disks, followed by large motor graders which cut to a total depth of about 4½ in.

Experienced operators are needed to do a proper job of mixing and aerating with the motor graders. At the start of operations, after the bituminous-sand mixture is laid down by the traveling-plant mixer, great care must be exercised to keep the grader from cutting too deeply. Should this occur, the fresh mixture fails to provide sufficient tractive resistance, causing the bituminous sand to be squeezed out from under the rubber tires, resulting in sand boils or ruts.

Elimination of the sand boils and ruts usually entails considerable hand labor with shovel and tamper. The usual practice is to keep the depth of cut under 1 in. for the first pass of the grader, increasing to a 2-in. cut as the surface course becomes compacted.

Although the state's specifications permit aeration and mixing of the bituminous-sand surface course with a light pneumatic-tired, pull-type grader drawn by a light crawler-type tractor, the motor grader has proved more successful, principally because it requires only one operator, compared with two needed for the tractor and grader.

On some jobs where the compacted subgrade makes a poor service road during the placing of the first half of the surface course, it has been found advantageous to run the sand and bitumen for the other half of the road surfacing through the traveling mixer, spread it in position, and give it a light rolling without aeration. This 12-ft. width is used as a service road while placing the first half of the surface course. Then it is run through the traveling mixer a second time and placed in final position to complete the surface course.

Final compacting with steel rollers

Compaction of the surface course, other than that which it receives from the rubber-tired motor grader, usually is not started until aeration and mixing are nearly completed. At that time heavy flat wheel rollers weighing 300 lb. per inch width of wheel are placed in operation, with successive passes overlapping at least one-half the width of roller. This is followed by several days maintenance with pneumatic tired rollers until the surface is smooth.

The final operation is to place the armor coat on the completed surface course. This consists of a light penetration seal coat of 0.2 to 0.3

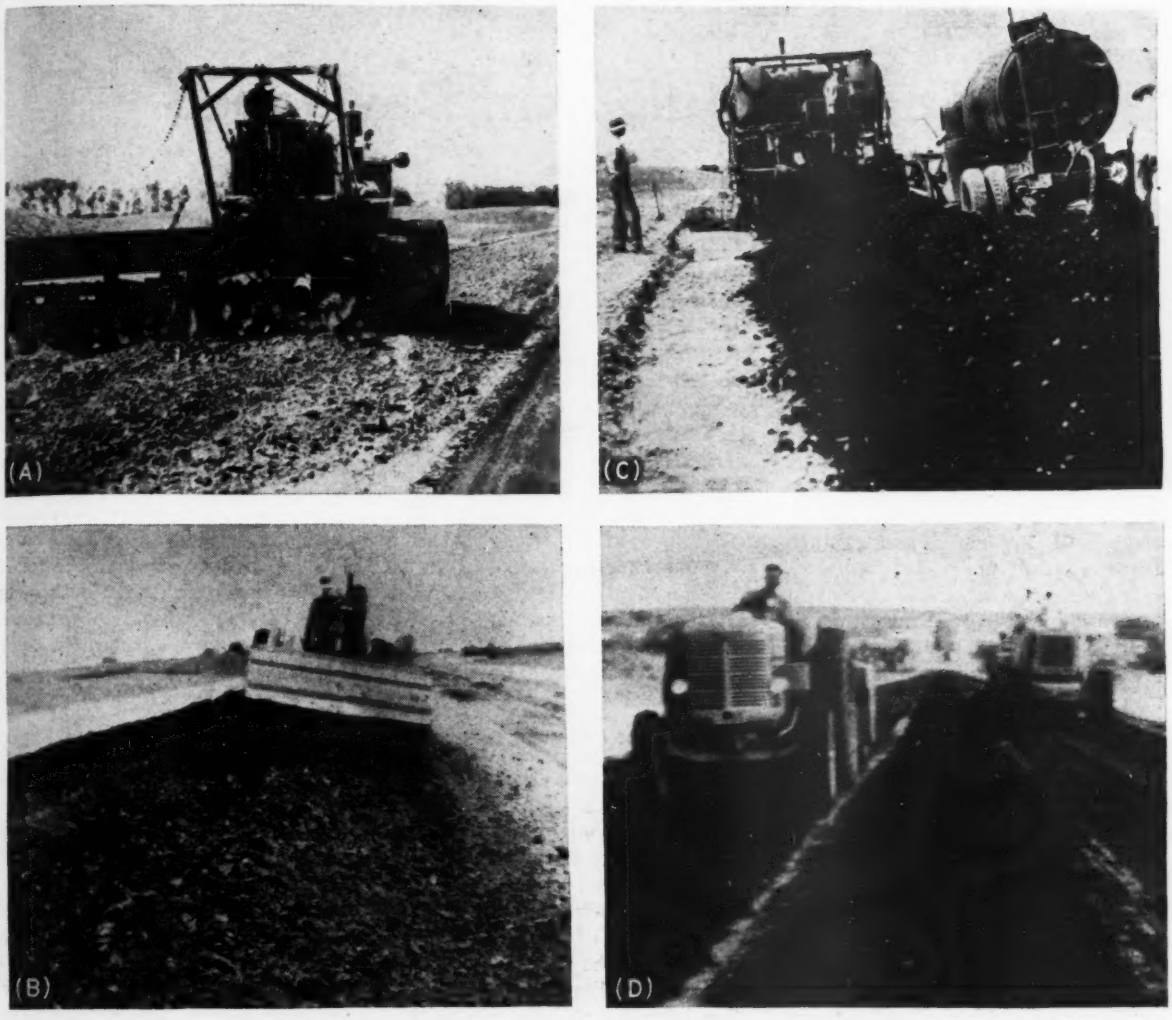


Fig. 4. Typical mat-laying operations include aerating and initial mixing by disking (A) and pulverizing (B), final mixing by traveling plant mixer (C), and compaction by rolling (D).

gal. per sq. yd., followed by a layer of special gravel slightly smaller than pea gravel. An RC-2 or RC-3 cutback asphalt is used in this seal coat, depending on job and temperature conditions at the time of construction. Application of the gravel, which runs from 12 to 25 lb. per sq. yd., follows closely behind that of the seal to insure proper embedment of the aggregate.

Initial rolling of the armor coat is by flat-wheeled rollers providing 8 hr. of continuous rolling per mile of road. This is followed by at least three days of maintenance rolling with pneumatic tired rollers, supplemented by light road drags to smooth the surface without damaging the armor coat.

Another unusual feature of highway construction in the Nebraska sand hills is that of protecting the embankment and cut slopes. Since native grasses will not take root on the freshly exposed sand, initial protection from surface wash is provided by covering such slopes with dry cured hay or similar material. Hay is usually used, since it is plentiful and costs only about $4 per ton.

This type of protection is applied to all cut slopes and ordinarily is extended about 4 ft. down over the shoulder slopes. In some instances, however, it is carried clear down to include the ditch bottom at the foot of the roadway embankment.

About 10 lb. of hay is used per square yard of surface to be protected. It is weighted down with a large shovel full of earth placed at 3-ft. intervals each way. Although it seems incredible, this method of protection prevents serious surface wash of the sand and eventually the hay catches enough wind-blown dirt and wild grass seeds to form permanent protection for the slopes.

Construction schedule

Construction of the 10.5 miles of bituminous-sand highway north of Greeley Center was started last Mar. 3. The excavation and embankment, estimated to total 340,000 cu. yd. was completed by Aug. 1, and the entire job finished by Sept. 1. The job will require some 6,200 cu. yd. of mineral filler and about 85 carloads of bituminous oil.

All construction is under the field supervision of A. E. Moomaw, project engineer and J. M. Crook, district engineer, both reporting to Wardner G. Scott, State Engineer of Nebraska.

Special Equipment Developed To Pull Long Concrete Piles

CONCRETE piles up to 95 ft. long were pulled from the San Francisco Bay mud recently to remove a partially completed mile-long structure built in 1945 for an Army ammunition loading facility. The structure was planned as two 1,252-ft. loading piers connected to each other and to the shore by a Y-shaped approach some 3,000 ft. long. However, when the war ended, the project was cancelled with only some 500 of the 12,000 piles in place. The design called for reinforced concrete piles, 18 in. square and varying in length from 25 to 110 ft. (the longest pile installed was 95 ft.).

As solid ground in most places was deeper than El. —100, the design had called for skin friction piles up to 110 ft. long, 10 ft. of which were to be above water. It was determined by subsurface investigation and sample pile loading tests that with about 65 ft. of length of pile embedded in the soft bay mud, each pile would be capable of supporting the design load of 25 tons, of which the deadload was some 10 tons. Concrete piles were used as the use of long-length wood piles, because of their scarcity, would have delayed this high priority war job.

Before cancellation of the project, construction was being speeded to complete this facility, urgently needed to support the invasion of Japan. After V-J Day all equipment and supplies were removed from the site, leaving the partially completed project. At a later date, in order to rid the area of a navigation hazard, a contract was let for pulling the piles, the contract calling for the piles to become the property of the contractor.

Special equipment built

Special equipment developed by the contractor for this job included an A-frame, a 42x70-ft. barge (Fig. 1), and a pile-pulling yoke (Fig. 2). The A-frame, mounted on the barge, was made of six 18-in. WF steel beams and was capable of transmitting a pull of 200 tons. (The maximum pull exerted on 95-ft. piles was 120 tons.)

The barge carried the pile-pulling equipment and it had reinforced interior bulkheads to take the extra stresses from the A-frame. To provide extra buoyancy the barge was fitted with an outrigger on each side, each consisting of nine 5x5x7-ft. steel pontoon cells. Buoyancy was transmitted from the outriggers to the barge by four 18-in., 55-lb., WF steel beams which were welded to the under side of each outrigger and which extended under the entire width of the barge. A heavy timber bolted on the top of each outrigger and to the deck of the barge held the cells to the barge so that they would not pound the under side of the barge under the impact of wave action when no extra buoyancy was required.

In addition to the winches which provided the necessary power, the equipment on the barge included a steam-powered crane from which was suspended a jet pipe to help loosen the piles. The jet was made of a long 6-in. pipe which tapered at the tip to a 1-in. nozzle. Water pressure at the nozzle was 400 psi.

The pulling yoke, made of heavy steel plate, transmitted the pull to the pile by means of steel jaws on each side designed so that as the pull exerted increased, the grip on the pile would tighten. Stainless steel welding rods were welded in ridges to the face of the jaws to improve the grip.

Fig. 1. Barge-mounted A-frame pulling long concrete piles from San Francisco Bay mud. As can be seen from the angle of the barge, a pull is being exerted on a pile which has been driven to water level. Note the pontoon cell outrigger on the barge.

Pile-pulling procedure

The first step in pile pulling was to place the yoke over the top of the pile (Fig. 2). The piles were pulled loose by use of this yoke and the A-frame. After one was freed and moving easily, a steel cable choker was attached and pushed down to approximately the quarter point by boat hooks. The other end of this cable choker was later attached to the pile somewhere near the center point. When the cable choker took the load the pulling yoke was removed. Concrete that had been partly broken loose during the pulling due to the gripping action of the yoke was then broken off by workmen with boat

hooks in order to prevent injury to men or equipment from falling pieces. The piles then were transferred to a freight barge by a barge-mounted crane moored between the pile-pulling barge and the freight barge.

Jetting was done before the pile was pulled. The jet usually kept one or two piles ahead of the pulling. Piles placed entirely in soft bay mud did not require jetting.

The freight barge on which piles were hauled away from the site consisted of the bottom section of an old timber floating drydock. This was well suited to use as a heavy barge because it was large enough to carry some 50 piles and was wide enough so the piles could be laid across the deck.

The pulling work was done with relatively little damage to the piles. A few were broken because of handling methods used in placing them on the freight barge (piles were designed for four point suspension and a two point suspension was used). The contractor felt that, if necessary or desirable, most of the piling could be reused at another location. However, this was not done as the piles were sold to be broken up and used as riprap on sea wall construction.

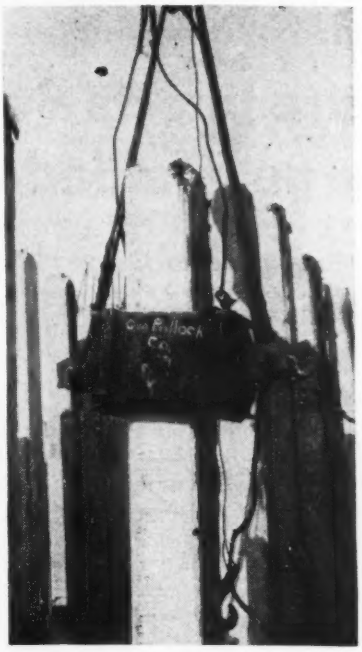


Fig. 2. This pile-pulling yoke shown in pulling position was one of the items of equipment designed and built specially for the job.

When the work started and the longer piles were being pulled, a good record for an 8-hr. shift was 20 piles pulled a day, particularly for those piles that required jetting. However, after the crew developed teamwork and the work progressed to the shorter piles, even better records were attained. For example, while pulling piles 60 to 75 ft. long, as many as 36 piles were pulled in one shift. The best record while pulling piles 25 to 35 ft. long was 53 piles pulled in one shift. This is better than one pile every 10 min. On the days cited when 36 and 53 piles were pulled, no jetting was required.

Direction of the work

The George Pollock Co., Sacramento, Calif., was the contractor on the pile-pulling job and developed the equipment and methods used. The design was by H. J. Brunnier, consulting engineer. Representing the Army on the design was R. B. Heronjeff, then acting chief, engineering division, San Francisco District, Army Engineers. Col. K. M. Moore was then district engineer. Subsurface investigations and tests were made by Dames & Moore, foundation engineers.

Cities Finance Public Works On Pay-As-You-Go Basis

An increasing number of cities are paying for municipal postwar public works projects without issuing bonds, according to a recent survey of cities of over 25,000 population by the International City Managers' Association. Two cities of the surveyed group are entirely debt-free. Six others have sufficient funds to pay off their small debts and are financing capital improvements almost altogether with current revenues. Other cities plan to finance as many capital improvements as possible on a pay-as-you-go basis.

Colorado Springs, Colo., and Kalamazoo, Mich., are entirely debt-free and both cities plan to finance extensive public works improvements during the next decade out of current revenues. A $4,500,000 construction program involving a new police station, three fire stations, a community center and other projects is being considered by Colorado Springs.

Kalamazoo has been out of debt since 1937 after boosting taxes in 1924 enough to retire outstanding debts. Since then the city has financed a new city hall, bridges, pavements, parks, an airport and other improvements without issuing bonds. Pay-as-you-go will be continued in Kalamazoo for a new water pumping station, a light plant and sewer lines.

Lansing, Mich, is another example of a middle-sized city (78,753 pop.) paying cash for public works. The city debt of $424,000 is offset by cash reserves. In addition, $1,800,000 is on hand to finance capital improvements. An annual levy of $500,000 for public works is expected to raise to more than $8,000,000 the total available during the next eight years for construction of a sewage disposal plant, fire station, auditorium and other projects.

Alameda, Calif., plans to finance public works projects with current revenues plus a backlog of cash accumulated during the war. The city debt of $243,000, which is covered completely by reserve funds, is being paid off as bonds mature. Fond du Lac and Milwaukee, Wis.; Cleveland Heights, Ohio, and Macon, Ga., also are debt-free for all practical purposes. Each has enough reserve funds to retire all its bonds as well as to finance extensive public works. Schenectady, N. Y., and Columbus, Ga., also operate on a pay-as-you-go basis although they have comparatively larger debts.

Some cities with small debts have not adopted pay-as-you-go plans. Among these, Evanston and Decatur, Ill.; Menominee, Wis.; San Jose, Calif.; and York, Pa., instead have adopted the policy of building up credit reserves for future financing of public works projects through bond issues.

Temperature Effects Being Studied On Large Welded Girders

La Motte Grover
Chairman, Structural Steel Committee,
Welding Research Council

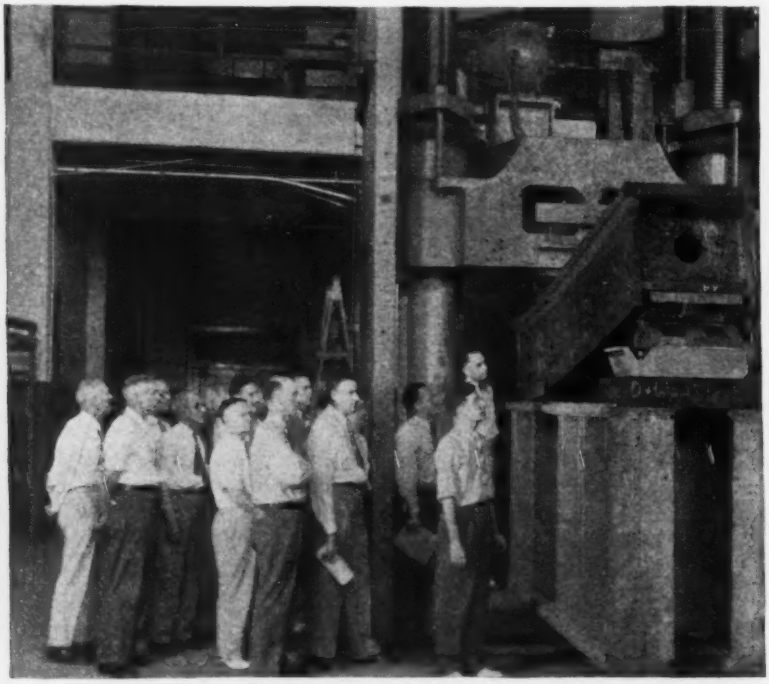
THE THIRD of six 9-ton welded steel box girders has been subjected to load tests in a program being carried out at the National Bureau of Standards for the Structural Steel Committee of the Welding Research Council of the Engineering Foundation to determine effects of various temperatures on load capacities. This last girder was tested at room temperature, as was Girder No. 1, but the latter was fabricated of ordinary semi-killed steel hull plating taken from shipyard stock, while special fully killed steel meeting the requirements of the American Bureau of Shipping for structural steel for hulls was used in the other five girders. [Fully killed steel is steel that was sufficiently oxidized during manufacture to prevent gas evolution during solidification of the metal—EDITOR]

Girder No. 2 was tested at 45 deg. below zero F. All girders are 22 ft. span, 2½ ft. wide and 2 ft. 1⅛ in. deep.

It is the purpose of the research program to investigate the effect upon the capacity of a welded structural member of severe geometrical constraint against ductile behavior, when the restraint is caused by general shape and proportions and by the use of thick material (1½-in. tension flange and side plates) without the deliberate introduction of a notch-effect of some kind. A further purpose is to observe whether there may be any detrimental effects of residual stresses; very abusive welding procedures and sequences being used in the construction procedures, along with some unfavorable details of design. A feature that has impressed bridge and structural engineers is that the girders have been successfully proportioned to insure against failure by lateral deflection and buckling or twisting, as test beams and girders usually fail. The compression flange was made 2½ in. thick.

The recently tested third girder was sustaining a load of 1,685,000 lb., equally distributed between two load-points 2 ft. 6 in. on either side of mid-span, when the center deflection reached 18.06 in. The permanent center deflection after removal of the load was 16.45 in. The extreme fiber stresses, computed under this loading, as for a modulus of rupture, were 91,200 psi. in the projections of the side plates and 70,200 psi. in the tension flange plate. It is probable that the 70,200 psi. stress was actually realized. The load required to deflect the girder continued to increase up to the end of the test, although at a greatly diminished rate after plastic flow became quite general in the middle portion of the girder. No indications of incipient fracture were observed, but the extensive electric strain gage readings have not yet been reduced and analyzed.

The first girder, of semi-killed steel, also tested at room temperature, failed by rupture with a brittle or "cleavage" type of fracture and a sudden release of energy that produced a loud report and shook the building; but failure did not occur until the measured strains and elastic deflection indicated extreme fiber stresses approximately equal to the conventionally determined ultimate tensile strength of the material, not far below the modulus of rupture of



Investigators at Bureau of Standards observe 9-ton welded girder under test. The load is 1,685,000 lb. on a 22-ft. span, and the deflection, 18.06 in., is all the testing machine will take.

75.6 kips per sq. in. as computed for the breaking load of 1,397 kips and corresponding bending moment of 71,200 kip-inches. The fracture was propagated across the tension flange up the side plates to the compression flange within a split second, its course being almost entirely in the base metal. The total deflection at the time of failure was about 8 in., of which a little less than 1 in. was an elastic deflection, the remainder being permanent set. Plastic deformations measured near the point where fracture started were well below one percent, reflecting the constraint that had been imposed upon ductile behavior and that had prevented much localized absorption of energy in the region of fracture.

The second girder, of fully killed steel, tested at about 45 deg. below zero, F., failed likewise by brittle or cleavage type fracture, but in this case the fracture was more of a compound, shattering type, and the entire girder snapped in two. The breaking load of 1,165 kips was, however, only 16.5 percent lower than that for the first girder, although it was very substantially lower, 30.9 percent, than the maximum load imposed upon the third girder, constructed of the same fully killed steel but tested at room temperature.

The deflections of the second girder could not be measured accurately during advanced stages of the loading because of the failure of the apparatus that was set up for taking deflection measurements within the enclosure for the dry ice used to lower the temperature. However, based on strain-gage measurements the total deflection at a load of 1,000 kips was believed to be only about 1.38 in., of which some 0.56 in. was permanent set.

Future plans indefinite

Decision has not yet been made as to the course to be taken in the remainder of the investigation. It may be devoted in part to a study of the effect of changing some of the details of design, or it may be devoted entirely to a study of the effects upon the behavior of the steel material produced by normalizing furnace heat treatments subsequent to construction, by preheating during welding, and by testing at intermediate temperatures. A further girder may be constructed of semi-killed steel, similar to that of the first girder, for testing at low temperature.

Very valuable supplementary data are being developed by extensive auxiliary tests of the steel material of each of the test girders at the Naval Research Laboratory, Anacostia Station, Washington, D. C.

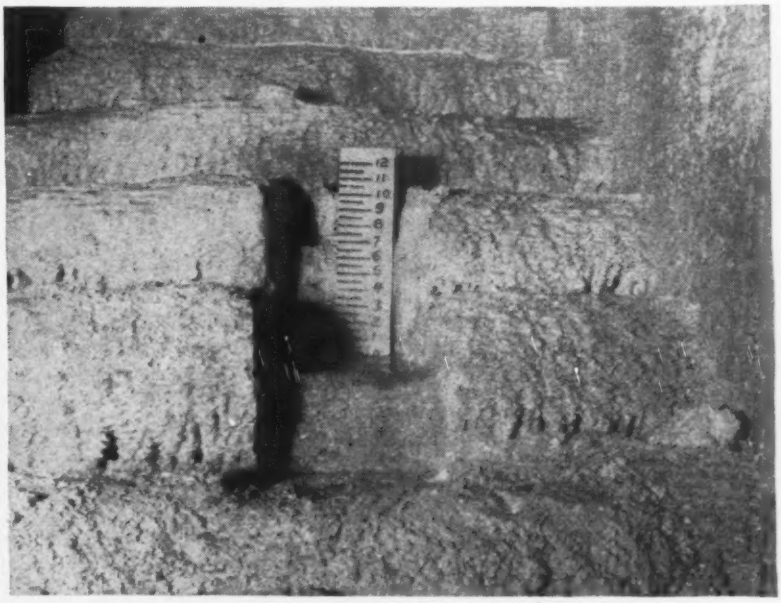
The construction of the first three girders was carried out under the direction of Milton Forman, welding engineer for the Ingalls Shipbuilding Corp. at that company's plant. The testing of the girders is under the general direction of H. L. Whittemore, chief of the Engineering Mechanics Section, National Bureau of Standards, and under the direct supervision of A. H. Stang.

Heavy Deposit Leached from Concrete Found in Gallery of Dam

Unusually heavy deposits, presumed to be chiefly calcium compounds, have occurred in a gravity-type massive concrete dam that was built in the Northwest some 30 years ago. No concern is felt for the safety of the structure, despite the relatively poor concrete, as the weight of the dam is much in excess of that required to resist the thrust developed by water of the depth impounded. However, interest attaches to the manner in which soluble material continues to leach out of the concrete so long after construction.

No data are available on the rate at which deposition occurred, though the engineer now in charge of the structure recently reported "while there is a continual secretion of deposit both on the stairway and on the side walls, the rapidity of deposition seems to be much slower than in the first few years after the completion of the dam in 1915."

The accompanying picture was made recently to show how heavy the deposit has become. Seepage coming through the side of the inspection gallery retains the carbonaceous material in solution while the water is under pressure in the process of percolation. Once released to atmospheric pressure in the gallery, the water tends to evaporate as it slowly trickles down the stairs. In this way the solution becomes super-saturated and deposition occurs.



A portion of this deposit on the stairway of an inspection gallery through a concrete dam has been cut away to expose the stairs beneath. Depth in inches is indicated by numerals on the card.

Major Heavy-Duty Concrete Runway With No Expansion Joints

BUILDING a heavy-duty concrete runway with no expansion joints is an innovation in Army airfield work which has been used at the Fairfield-Suisun, Calif., Army airbase. After completion of the runway, the heaviest pavement yet installed by the Army, observations will be made on test sections for a period of a year to determine the relationship, if any, between slab temperature and pavement movement. In this manner, Army officials hope to establish the feasibility of thick pavements with no expansion joints.

Although the Fairfield-Suisun runway is the first Army concrete pavement in which expansion joints are omitted, other runways have been so constructed. An example is a 4,000-ft. concrete runway built some five years ago for Douglas Aircraft Co. at Santa Monica, Calif., which has shown no signs of distress in that period.

Runway location and layout

The Fairfield-Suisun airbase is the Pacific Coast headquarters of the Air Transport Corps and is located some 50 miles from San Francisco in a fog-free area. The operation of smaller runways in the vicinity has established the fact that wind continues in the prevailing direction about 95 percent of the time; hence, it was decided to rely on runways at this field in only one direction.

The new runway is laid out parallel to and 1,000 ft. from an existing runway which can be used by planes as large as a B-29 Superfortress (the new pavement is designed for heavier loads). The two strips are offset so that a minimum of taxiing is required. In this manner, planes that land on one runway will be close to the various airbase facilities, and planes taking off from the other strip will be close to these facilities at the start of their flight.

The runway pavement, 200 ft. wide and 8,000 ft. long, was built in eight strips 25 ft. wide. All concrete runways and taxiways in the new construction were designed for gross loads of 375,000 lb. (the new Northrup "Flying Wing" has a weight in-

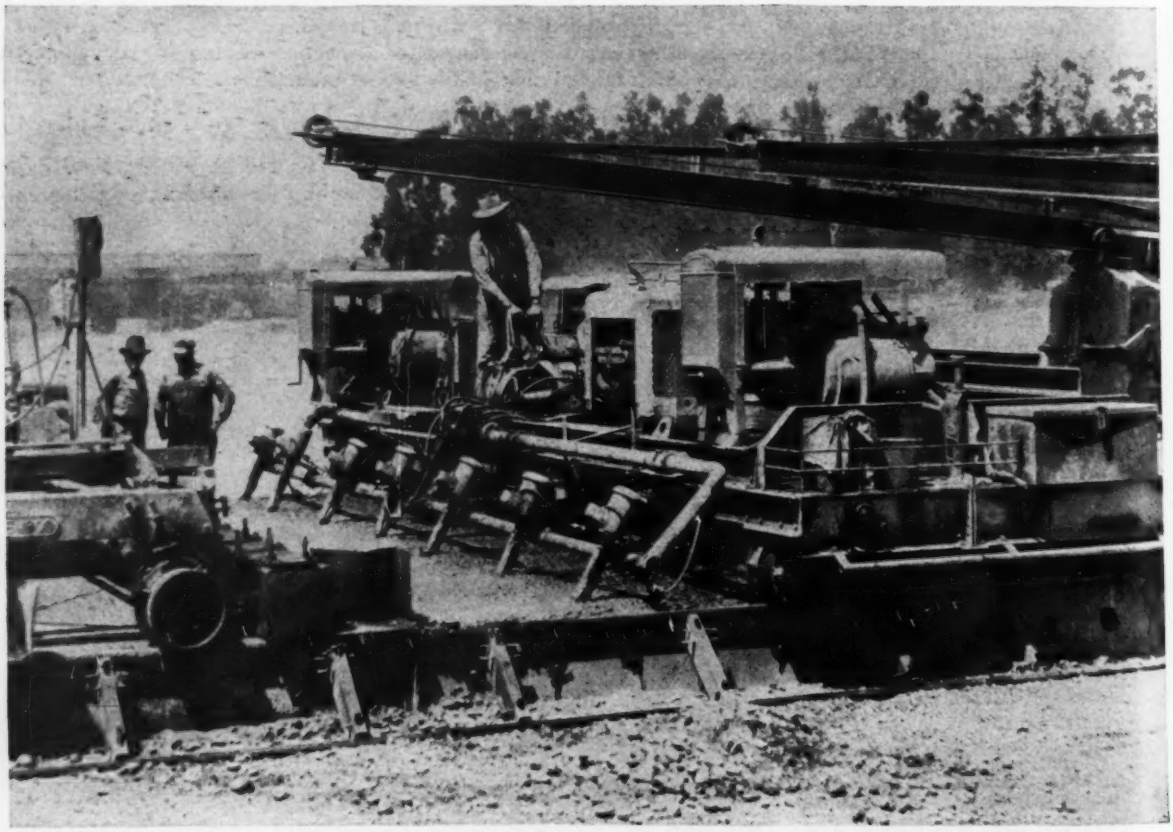


Fig. 1. Paving a 25-ft. wide strip of the concrete runway. The steel forms in the foreground show the 18-in. pavement thickness. Seven vibrators in line were used after studying results obtained with other arrangements.

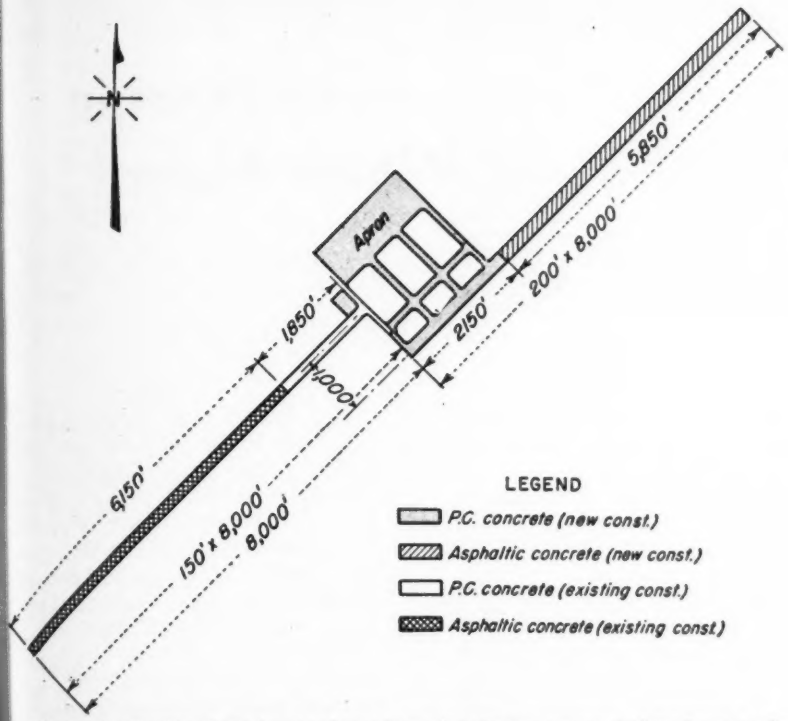


Fig. 2. The darkly shaded area shows heavy concrete runway and taxiway paving with no expansion joints installed at the Fairfield-Suisun air base. The existing NE-SW runway is on the left and the new runway is on the right.

cluding its overload of some 210,000 lb.).

The first 2,150 ft. of the new strip (the portion adjoining the apron and taxiway system) has heavy concrete paving 18 in. thick, increasing to 27 in. in the outer 25 ft. on each side of the 200-ft. paved strip (Fig. 2). The concrete pavement is placed on 12 in. of prepared subgrade. The remainder of the runway consists of a 6-in. thick asphaltic concrete surfacing laid on some 58 in. of prepared subgrade. Some of the innovations in subgrade preparation at this airfield were discussed in *ENR* Mar. 21, 1946, vol. p. 422.

Taxiways at the Fairfield-Suisan base are also made of heavy concrete pavement as they are required to take the vibratory stresses caused by heavy planes ground-testing their motors. These taxiways are 200 ft. wide and average about 1,500 ft. in length.

Although the concrete pavement has no expansion joints, contraction joints have been placed at 12½-ft. intervals. These contraction joints are merely weakened planes used to control shrinkage cracks. They were formed by placing metal strips in the freshly poured concrete at the required 12½-ft. intervals. The metal was removed after the concrete had taken its initial set. Dowels on 18-in. centers are used to provide shear transfer between contiguous 25-ft. pavement strips.

As previously stated, the Fairfield-Suisun paving is the first portland-cement concrete runway work the Army has done without expansion joints. The policy of omitting such joints cannot be attributed to any one man or any one of the offices of the Corps of Engineers. Many events and many individuals are said to have had a hand in the adoption of such a policy. The district engineering force, division engineers, representatives of the Chief of Engineers, advisors from the cement industry, and the like all were partially responsible for the expansion joint omission. Some state highway departments have built experimental sections of pavement having no expansion joints, with satisfactory results, according to those who made the tests.

It is believed that the mass of this heavy pavement will absorb any expansions that may result due to the heat generated while taking initial set. Expansions due to temperature changes will be minimized by the mass of the concrete and the fact that the pavement will take some time to heat through.

To provide the required concrete compaction, it was necessary to vibrate the concrete. To accomplish this a scheme was devised whereby vibrators were attached to the concrete spreader (Fig. 1).

Seven vibrators for 25 ft. width

Several vibrator patterns were tried to find the most suitable for this work. The original set-up was with six electric vibrators in a row. This did not seem to achieve desired results so the pattern was changed to a staggered pattern of two rows of three each. This also, was not entirely satisfactory and the final arrangement was as shown in Fig. 1, one row of seven vibrators.

Paving at the Fairfield-Suisun airbase is being done under the direction of the Sacramento District, U. S. Army Engineers, by Morrison-Knudson Co., Inc.

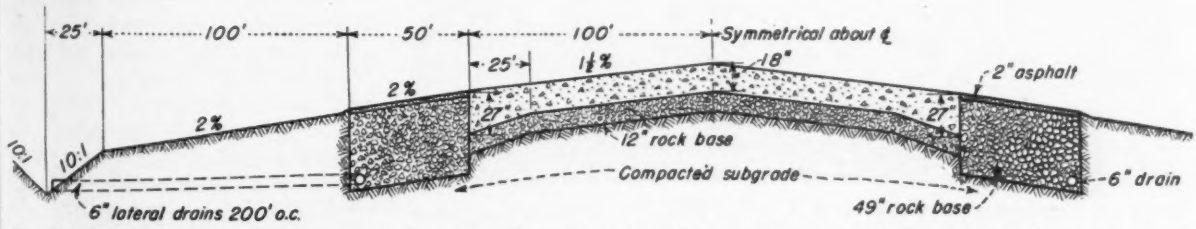


Fig. 3. Typical section of the concrete runway. Under the 18-in. thickness of concrete there is a 12-in. base of crushed rock on top of compacted subgrade.

Mechanically Applied Cement Mortar Used to Reline 31-in. Water Main

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Contents in Brief—Because of deterioration of the existing lining, 10,880 ft. of 31.4-in. steel trunk line supplying water for the Los Angeles Harbor area was relined recently by use of a centrifugal cement-lining machine. Methods of cleaning the pipe, consideration involved in use of the lining machine and resultant costs and hydraulic characteristics are discussed.

PLACING a ¼-in. cement-mortar lining in some two miles of 31.4-in. steel pipeline was recently accomplished in Los Angeles without removing the pipe from the ground and at relatively low cost. The pipe is a water supply trunk line in which deterioration of the original lining had become serious. The relined pipe showed marked improvement in hydraulic characteristics.

Features of the work were effective use of centrifugal lining methods and good preparation of the interior surface by efficiently organized hand cleaning methods. The line was out of service only a short time despite a diameter which was small for efficient work.

The section lined was 10,880 ft. long and contained ⅜-in. thick welded steel pipe with cement-calked bell and spigot joints. It is part of a trunk line supplying water to the Los Angeles Harbor area. Before installation in 1935, it was coated inside and out with bituminous enamel. In 1943, small flakes of enamel were found in meter screens. By late 1945 the amount of enamel thus found was great enough to require remedial measures. The harbor trunk line was the first pipe to be processed through the Los Angeles Department of Water and Power coating plant and officials believe that failure of portions of the lining can be properly charged to pioneering in this type of bituminous coating.

Bacterial slime removed

Just before the line was taken out of service for relining as the first step in preparing the inside of the pipe for its new lining, chlorine in strong concentrations was introduced at the upstream end to remove the bacterial slime clinging to the sides of the pipe.

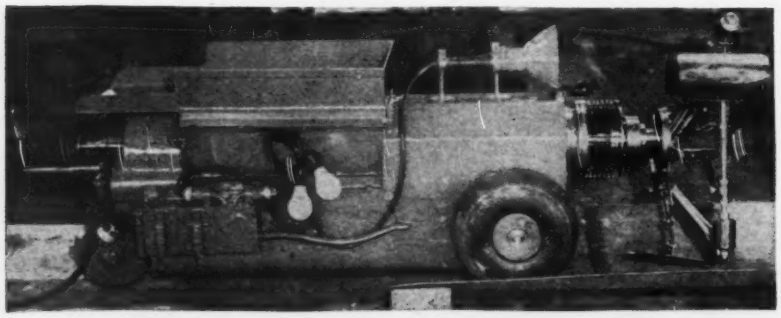


Fig. 1. A compact machine was used to reline 10,880 ft. of 31.4-in. diameter water main in Los Angeles. Cement-mortar in the hopper is spread on the pipe by the centrifugal dispensing head and troweled smooth by slowly revolving trowels.

Use of chlorine for this purpose is still more or less experimental and sufficient data to predetermine required concentration are not available. In this particular pipeline, chlorine was introduced at the upper end at the rate of 50 ppm. and allowed to carry downstream at a rate of two feet per second. Application was continued until concentrations of 15 ppm. appeared two miles below. This line was then closed, chlorination stopped, and the solution allowed to "cook" overnight before flushing. The results proved quite satisfactory.

Access points provided

After dewatering the line, access holes were cut and cleaning work by hand methods started. This work was intended to remove all loose enamel, tubercles, rust and slime, and also to scarf the edges of the enamel remaining on the pipe so as to present no abrupt, sharp-edged surfaces to the lining machine. The most effective crew included nine men, deployed so that five were scraping, two collecting and carrying debris out of the line in sacks, one tending the light plants and blowers, and one man to act as lead man or "pusher."

After a section was scraped and scarfed, five men returned over the line with ordinary kitchen scrub brushes to remove any slime remaining after chlorination. Two men operated an air jet over the previously cleaned and scrubbed section to remove dust and other small particles. Working in this manner, the men were able to complete an average of 475 ft. a day where the lining was in poor condition, and up to 1,200 ft. a day in sections where lining required scraping only at joints and widely separated patches.

In the cleaning operation, illumina-

tion was provided by portable, 500-watt, lighting plants with extension cords; concentrated light for each man was also provided by head-band type flashlights. Circulation of air was effected by the use of light portable blowers delivering through canvas tubes. A heavy blower was used to dry the lining in advance of the scraping work.

It was necessary for the men to apply protective cream to exposed portions of skin to protect against irritation from volatile vapors of the enamel lining, wear fog-proof goggles to protect the eyes against dust and particles, and, while brushing and blowing, wear respiratory masks as protection against iron oxide dust and fine particles.

Lining the pipe

After the pipe was cleaned and dried, it was lined by use of a centrifugal cement-mortar lining machine. Although the nominal thickness of the new lining was $\frac{1}{4}$ in., specifications permitted variations of $\frac{1}{16}$ in. plus or minus. The operation of such a machine was described in *ENR*, Sept. 10, 1942, vol. p 372. Two troweling methods were tried. The first used two shafts, one shaft turning opposite to and inside the other, each turning two spring-loaded levers supporting trowels. The other method used one shaft turning three levers with trowels. The Los Angeles work was started with the four-trowel method but was later switched to the three-trowel as a more desirable finish resulted.

Valves lifted out

The machine was unable to pass two 24-in. gate valves on the line, so these valves and their reducers were lifted out and sent to the contractors' yard for handplastering and controlled curing. The opening in the line made by gate removals was utilized as the point of entry for the lining machine.

A problem arising in connection with the lining operation was the spacing of holes for access to the work by men and materials. The closing of an access hole by a welded plate cover required about three hours, during which time men and machinery were idle. This condition made frequent openings undesirable. On the other hand, excessive distance between holes resulted in frequent machine shutdowns due to difficulties of maintaining an adequate mortar supply. Consideration of these factors led to a spacing of 475 ft. between access holes.

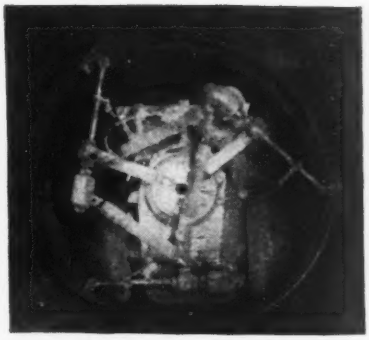


Fig. 2. Lining thickness is controlled by rate of advance of the electrically operated machine. The tire on the right is deflated slightly to furnish extra resistance to torque.

Fig. 3. This hand tool, specially developed by the Los Angeles Department of Water and Power, is being used to clean a bell and spigot joint. Cleaned bituminous enamel lining can be seen in the foreground.

Cement mortar was introduced into a line at the nearest access hole in advance of the machine's progress. Four buggies, each 1 ft. wide, 1 ft. deep and 2 ft. long, were used to transport mortar to the machine. One man was assigned to each buggy. The first man to receive a load in his buggy, placed a piece of plyboard on the top, lay on his back on the board and propelled the apparatus through the pipe to the machine where he dumped his load in the bottom of the pipe and brought the empty cart back until he met the next man coming up. At this point the empty cart was passed over the full one, the first man again took the full cart to the machine and the empty cart was passed down the line from man to man, and so on back and forth. Thus, it was not necessary for the men to pass each other in the pipe. Mortar was placed in the machine by the operator and his assistants.

Good progress made

Under favorable conditions the machine could average 600 ft. of travel per day. As this is greater than the distance between access holes, when the machine closed down for the night between access holes, a coverplate was welded on the line at the first access hole in advance of the machine's progress. This coverplate contained a 6-in. extra heavy coupling through which mortar was delivered until the machine reached the hole. When this occurred, about four buggy-loads were stored in the pipe and the four buggies loaded, the power cable was quickly retracted and re-entered through the next hole, a cast iron plug was inserted in the coupling, and the machine continued to operate while the other surface machinery was being moved to the next hole. If the machine approached an access hole at the end of a shift, a solid cover was put in place by a welder before starting time the next morning.

The mix used was two parts of cement to three of sand. In addition to the moisture in the sand, $2\frac{3}{4}$ gal. of water per sack of cement was used.

The bond obtained between the new lining and the existing pipe was excellent. This was shown in a section some 600 ft. long which was less than standard thickness and removal was required. It took nine men $2\frac{1}{2}$ days to remove the lining placed in one day. In many instances, a thin top layer of enamel was pulled off with the mortar.

Curing method

Curing was effected by keeping the newly lined section closed off to the circulation of air. When it was necessary to have manholes open, they were covered with burlap. Temporary brick bulkheads were erected at the open ends of the pipe where sections

had been removed in order to further avoid draughts. As soon as possible after lining, the line was filled with water.

Cracks appeared in the lining in two places. In one instance, it was necessary to enter a section for other repair work two weeks after lining. Movement of air was sufficient to dry the line and cause cracks to open in the lining. In another instance, during an unseasonably warm day two or three cracks opened at a manhole. All cracks were repaired by rubbing in neat mortar.

Cost of this new lining was $3.30 per ft. This figure includes the following: (1) Work done by contractor, including placing mortar lining and furnishing and installing six additional permanent manholes—$2.582, (2) work done by Department of Water and Power employees, including flushing, draining, cleaning and drying pipeline—$0.613, and (3) inspection—$0.105.

Hydraulic characteristics improved

The effect of the new lining on the hydraulic characteristics of the line was demonstrated by a series of flow tests. By means of the tests; the constant *C* for use in the Hazen-Williams formula was determined. Average values for this "degree of roughness" constant were as follows: (1) before lining, before chlorination—123; (2) before lining, after chlorination—129; and (3) ten days after completion of the lining—143.

Contractor for the lining work was the American Pipe and Construction Co., Howard Jenkins, vice-president and general manager. The pipe was lined with machines manufactured by the Centriline Corp., New York.

Samuel B. Morris is general manager and chief engineer of the Department of Water and Power, City of Los Angeles, and Laurance Goit is chief engineer of waterworks and deputy general manager. Cleaning and inspection of the pipe was done by personnel of the water distribution division, E. W. Breitkreutz, engineer in charge. The author was chief inspector on the job.

Cables of 90-Year-Old Bridge Still in Sound Condition

Suspension bridge cables in the Bidwell Bar Bridge, the first suspension bridge west of the Mississippi, are still in place after 90 years of service. All the materials for the bridge, which will be taken out of active service on the completion of a new bridge downstream, were brought "around the Horn" on sailing vessels and hauled overland some 200 miles to the gold rush town of Bidwell Bar near Oroville, Calif.

The 240-ft. bridge which spans the south fork of the Feather River was built in 1856 for some $35,000 by the Bidwell Bridge Co., an organization formed for the purpose, which operated it as a toll bridge until 1889. The origin of the materials making up the bridge is difficult to determine as the records of the original company have been lost. However, the towers bear the markings "Made in Troy, New York."

The bridge is supported by four main cables, each 3 in. in diameter and each containing 300 No. 10 wires. The cables were protected when installed by a coating of beeswax. No other protective coating was used until the bridge was taken over by the county road department some 30 years ago. When an inspection was finally made, the cables were found to be well preserved by the beeswax. The bridge now has a coating of aluminum paint which gives it a touch of modernity.

[Cables made about 1856 would have been formed of wrought-iron, which is resistant to corrosion. Hence, even without the beeswax, they should be in sound condition—EDITORS]

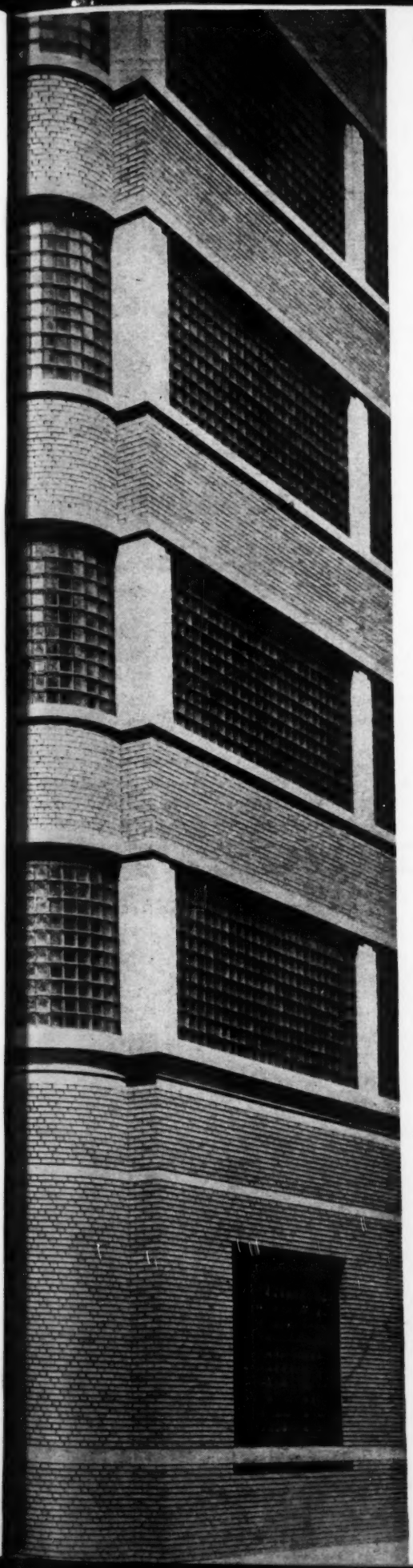
Piers and cable anchorages were made of rock, brick and mortar. Eyebolts were fastened in place in the anchorages with melted sulphur which expanded on cooling. The orginal piers and eye-bolts are still in service.

The deck structure has been almost entirely replaced. Floor beams are 4x6-ft. timbers spaced some 3 to 4 ft. and have been partly replaced. The stiffening system, made originally of wood, was replaced in 1922 with a light metal stiffening truss. The bridge is decked with 4x6 timbers covered with an oil road mix.

In the fall of 1945, a 5-ton limit was placed on this bridge. As a result, school children were required to dismount from their school bus, walk across the bridge, and wait for the bus to cross. A movement is under way to make the bridge and a nearby picnic ground a state park.

The new bridge, to be located about a quarter mile downstream, will be reinforced concrete structure of continuous girder design. Designs made for Butte County by the Don R. Warren Co., have been approved by state and PRA officials as the bridge is receiving both state and federal financing.

Fig. 1. This 90-year-old, 240-ft. suspension bridge near Oroville, Calif., will be retired when a new bridge downstream is completed. The cables have been in use since 1856.



TOWARD BETTER BUILDING

A Special Section

- Design of Industrial Laboratories
- Good Roofs Require More Than Mopping
- Improved Framed Walls for Houses
- Why Slab-Band Floors are Economical
- Practical Methods to Avoid Cracked Walls
- Steel Building Specification Changes
- New Ideas for Housing

FUNDAMENTALS IN THE

Design of Industrial Laboratories

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Voorhees, Walker, Foley & Smith, Architects and Engineers
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***Contents in Brief**—In the design of industrial research laboratories many perplexing problems are encountered, of which provision of services is perhaps the most complex. Flexibility in use of space requires the services, as well as light, heat and air conditioning, to be available wherever they may be needed. For economy of space, they must be compact, and quite often, the layout of the building and the type and location of structural members are affected. Solutions of some of the more difficult planning problems are illustrated by selections from actual designs.*

MODERN industrial research laboratories are essentially a complex combination of mechanical services that must be consolidated and simplified so that the resulting buildings are economical, convenient and handsome. Elements in laboratory design include selection of site, flexibility of layout based on repetitive use of an efficient, economical module and on provision of services wherever they may be needed, structural design in accordance with space requirements, and architectural treatment for attractive appearance and integration of the components.

Laboratory design presents problems that vary with the type of research to be performed and with the owners' desires. Solutions used successfully in specific cases indicate how Voorhees, Walker, Foley & Smith, architects and engineers, has overcome these problems. In many cases, the principles involved apply to other types of buildings as well, and the techniques employed may be helpful to others in solving analogous situations.

The novelty and complexity of the problems of laboratory design led this firm some years ago to recommend to the Bell Telephone Laboratories that they build a full-size "test-house" of several modules of a proposed laboratory building (*ENR* Feb. 26, 1942, vol. p. 344). In addition to substantiating in our own as well as in the owner's minds the validity of design decisions made, the model provided an opportunity for the subcontractors who were to build the laboratory to see exactly what would be expected of them, and as a result, better bids for the work were forthcoming, than would have been obtained from complex plans and specifications alone.

Rural location sometimes preferred

Where fundamental research is a prime consideration of the laboratory, there has been some tendency of late to select a site somewhat remote from the manufacturing facilities in order that the research scientist might not suffer interruptions by production men with questions about procedures and methods, and also to provide a more pleasant atmosphere in which to work.

Another consideration which may

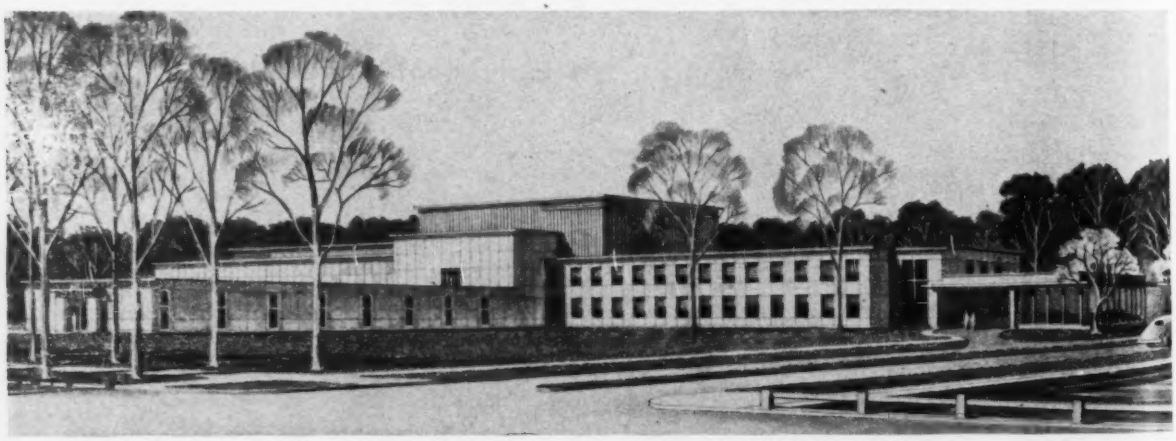


Fig. 1. Most complex of a primary group of eight structures comprising the Ford Research and Engineering Center, the Dynamometer Building, will house 32 sound-proofed dynamometer cells of 200 hp. and two of 500 hp. Costly electronic, mechanical, ventilating and piping facilities will be installed.

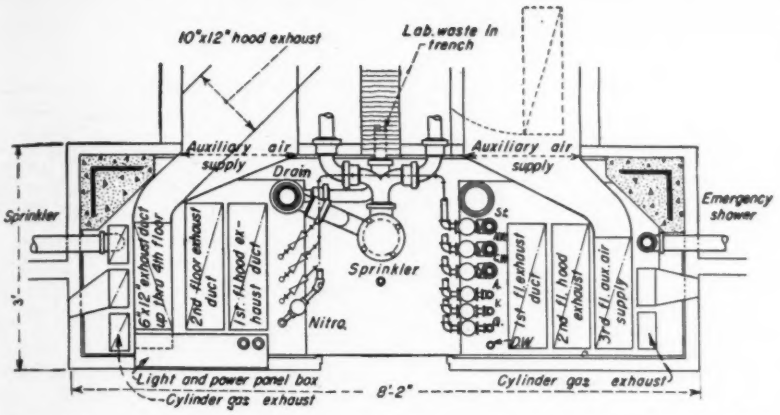


Fig. 2. Plan of service shaft located at the corridor in a laboratory building for a chemical company. Steel angle columns are used to minimize space needed for structural members.

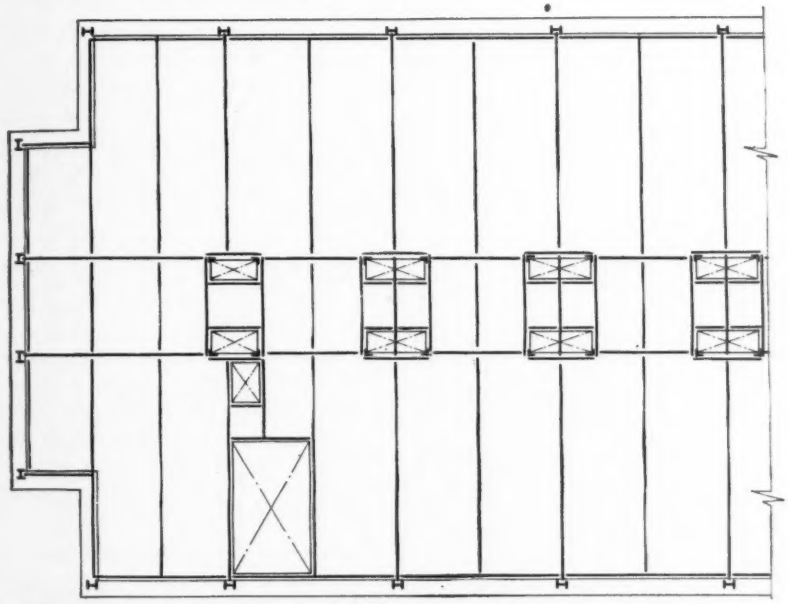


Fig. 3. Typical part floor framing plan showing central location of service shaft illustrated in Fig. 2. Repairs on supply lines can be made from the corridor.

tend to influence the selection of a suburban or rural site away from the manufacturing facilities is that research appears to be a rapidly expanding function of industry and the industrial site may not offer sufficient land for a large expanding development. It is well to bear in mind the distinction between process control, product improvement, product development and fundamental research. Of these laboratory functions the pure research may more easily be divorced from production facilities while the others may of necessity be located quite close to the factory. The size of the research laboratory and the functions of its component parts, as well as the policy of the management, tend to determine whether the research laboratory will be housed in a single consolidated structure, or whether a group of structures arranged in a manner similar to the average American college campus is the solution to the problem.

In planning an industrial laboratory building, the first analyses are generally those of the space requirements, and an attempt is made to boil these down to their simplest denominators in terms of space dimensions. The goal is to achieve what might be called "universal space" so that flexibility in rearrangement of spaces and equipment can be achieved quickly and economically. This "universal space" is rarely ever achieved since the requirements for what might be called a standard research laboratory unit require radically different dimensions from those of a semi-works or pilot plant. With considerable study of requirements it is possible to arrive at two or three types of space within which nearly all of the laboratory functions can be properly and conveniently housed.

The section of the building that houses the bench type laboratories is much more complex in its facilities and generally has finer interior finishes than is usually found in the semi-works or pilot plants. The equipment of the bench type laboratory consists generally of standard units of benches, fume hoods, racks, desks and other pieces of "furniture" which may be arranged in a variety of patterns to suit the working requirements of the occupants. A study is made to determine the furniture arrangements that are likely to be needed by all occupants, and a module or unit of space is decided upon.

Layout based on module

The laboratories then are varied in size by the number of units or modules of space which are assembled between dividing partitions. Each module is planned to contain a window, artificial lighting, heating, air conditioning or ventilation and a complete set of the piped laboratory services and electrical power. With these facilities provided on a modular basis it is then possible to arrange or rearrange laboratory furniture and partitions without the necessity of making changes or alterations in the basic building structure and its mechanical and electrical conveniences.

The module is a complete laboratory unit with all necessary services. To produce a laboratory of any desired size it is only necessary to repeat the module. Selection of the correct unit is extremely important, as too large a module results in a lack of flexibility while one too small results in excessive costs because of the unnecessary repetition of piping, wiring and ventilating equipment.

After the module has been determined, and only then, is it possible to begin the planning of the building

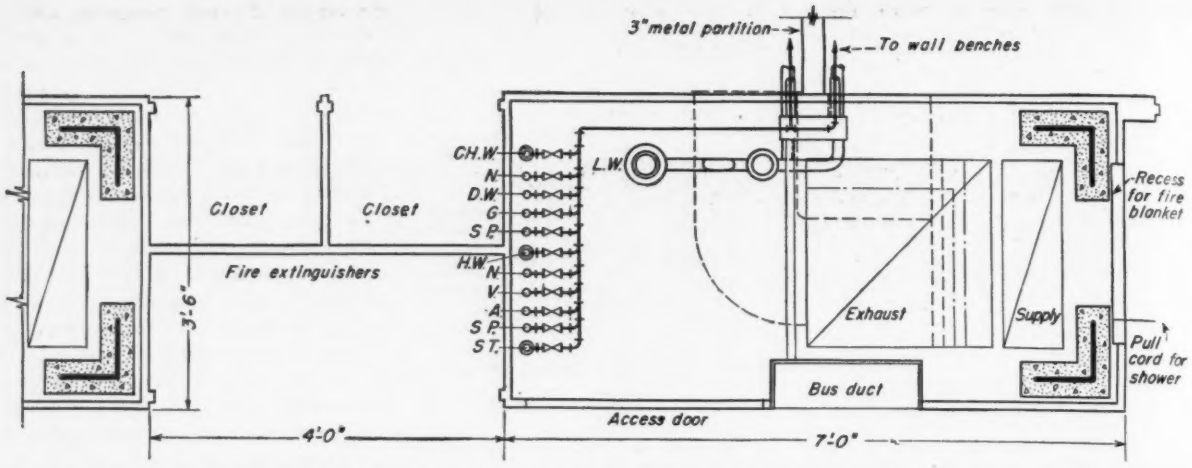


Fig. 4. Plan of service shaft for laboratory of an oil company. It is placed at a central corridor and angle columns are used.

structure and services, for they must be based on the module dimensions. For example, service shafts for wiring and piping occur in each unit. Structural columns are located along the lines on which partitions may be placed. Ducts are so arranged that wherever a laboratory may be placed a duct will be found. The module also dictates fenestration, since each unit must have a window, which may, in the case of a dark room or other special occupancy, be blocked out.

Service requirements

All laboratories require piping and wiring services, which vary from relatively simple to very complex. The greatest complexity is reached in the laboratories of a big chemical company, in which in one case it was necessary to bring to each module heat and light, conditioned air, steam, nitrogen, compressed air, gas, cold water, hot water, vacuum, cylinder gas distilled water, laboratory waste, 110-v. a.c., 220-v. 3-phase a.c., sprinkler piping and hood exhaust (Fig. 2).

The distributing mains for these services run either on the basement ceiling or in the attic and feed upward or downward in shafts at each module. Each service in the shaft is equipped with a tee or branch at every floor so that wherever service is needed, horizontal connection is readily made. The horizontal run to the outlet on the laboratory bench is either carried on the face of a partition or, as in the case of service to an island bench, by trench in the floor fill. In the design of the vertical riser groups, ingenuity is required to arrange the services so that a minimum of floor space is taken up, and yet all services must be readily accessible for maintenance and operational requirements.

The placing of these vertical service groups is important. In the case of the laboratories of a telephone company, it was found convenient and economical to run vertical mains on the outside walls of the building. In the case of the chemical company, this was impossible because the nature of the research work made it desirable to provide emergency escape doors in the side partitions near the outside wall, preventing the carrying of wiring and piping on the partition unless fed from the corridor end. The feeder shafts were therefore located at the corridor (Fig. 3). This arrangement carried with it the advantage that service crews working on supply lines could operate from the corridors without entering the laboratory itself.

In all cases, we have planned the pipe services so that none is buried in the structure, and all piping, whether mains, sub-mains or branch lines, is readily accessible for repairs or alterations. In the laboratories, the pipes are generally not visible, being covered by a removable metal wainscoting. Proper attention is paid in the design of the pipe services to ensuring provision of sufficient space for mechanics to install and to service the piping.

It has been found that some owners have placed considerable emphasis on the requirement that the servicing and installation of new pipes in the shafts shall not interfere with the working activities of the laboratories themselves and this requirement has been met very well by locating the vertical risers in shafts which are accessible from the corridors of the building rather than in the laboratories themselves, such as occurs when the risers are located in the outside wall. It is to be noted that the placing of the vertical pipe services along the corridor wall allows an intercommunicating door to be placed between laboratories, or an escape door if hazardous conditions prevail, remote from the corridor door and into an adjoining space without interrupting the laboratory piping which is generally placed along the walls.

Electrical and mechanical needs

The electrical distribution system has some peculiarities in that it is generally desirable that a current failure caused by the work in one laboratory should not affect operations being carried on in other laboratories. Since this necessitates an individual panel to serve each laboratory and since the electrical requirements are often heavy both in current demand and in the number of kinds of currents, voltages and frequencies required, the space needed to house the equipment requires the same careful planning as is needed for the pipe services.

The unusual amount of mechanical equipment as compared with that needed to operate a more conventional kind of building generally makes it necessary to provide an adequate basement and often an equally

adequate attic space to house this equipment. Where practical, it has been our policy to place all equipment of a service nature in the basement even if this equipment is serving but a single laboratory and is not a general service. This refers particularly to such items as pumps, generators, rectifiers, etc., which can best be serviced by the building engineer. In this way the laboratory space is conserved for strictly laboratory purposes.

In an effort to provide utmost flexibility for rearrangement of laboratories we have in most cases recommended movable partitions of which there are several types and materials available; and for uniformity of finish and appearance the same partitioning is used as wainscoting of the exterior walls, and to enclose the pipe and duct service shafts. Depending upon the degree of finish desired by the owner we have employed several ceiling finishes from the simple one of paint on the concrete slab to hanging acoustical metal pans with built-in lighting.

Air conditioning problems solved

In the laboratories that this firm has designed, complete comfort air conditioning either has been installed initially, or space for ducts and equipment has been reserved for later installation. Planning for air conditioning is a troublesome feature, since flexibility must be kept. Heat loads may vary greatly from day to day. Ovens, hot plates, motors and other heat-producing devices go and come with no regularity, and the room temperature and humidity are expected to remain fairly constant. A system of averaging room temperatures by use of several thermostats in series has been developed that satisfactorily solves this problem.

Recirculation of air from laboratories is usually undesirable because of the possibility of the presence of unpleasant or dangerous fumes. Therefore, the conditioned air supplied to the laboratory is discarded by exhausting to the outside. During cold weather, air at room temperature is supplied for ventilation, while to compensate for heat loss through glass and exterior walls, the room is warmed by convectors installed under window sills.

As appendages to the principal

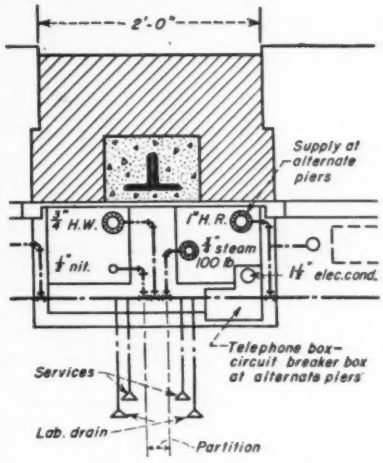


Fig. 5. Typical plan of service shaft located at exterior wall of a laboratory for an oil company. Angle columns are spaced 6 ft. apart.

laboratory function—the actual working space—there are other types of activity that must be provided for, such as, offices, rest and recreation rooms, dining facilities, libraries, medical services and garages. These are all secondary to the laboratories in importance but at the same time must be planned for and fitted into the general scheme in proper relationship to the laboratories and to each other. These subsidiary spaces are usually to be air-conditioned, but as recirculation is not objectionable, advantage is taken of this to reduce operating expense.

The question of providing or omitting windows in laboratories has been the subject of much discussion with the owners and while one would logically conclude that the omission of windows would be an asset to the research scientist in that it would make possible closer control of the conditions of light, temperature and humidity in his laboratory, this argument apparently bears little weight with human beings who have a strong desire to look out of the window. The problem, then, is one that the architect and engineer must solve; i.e., to provide a tight window with good insulating qualities and one which may be blacked out easily.

The structural design for laboratory buildings differs from the more orthodox building in that the engineer must devise a system which will fit with the service shafts but not obstruct them. This results in what might seem offhand as curious column shapes and spaces and unusual arrangements of beams and girders. A careful analysis of the structural design has proved, however, that while the structure may be somewhat more expensive than that of a more usual type building, the overall economies more than justify these arrangements.

In the laboratories of an oil company, where a 10-ft. module was adopted, standard steel H-column sections are used in the exterior wall, but at the corridor wall, where the service shafts are located, steel angle columns are specified. Here the spans could be limited to 10 ft. and the area of steel

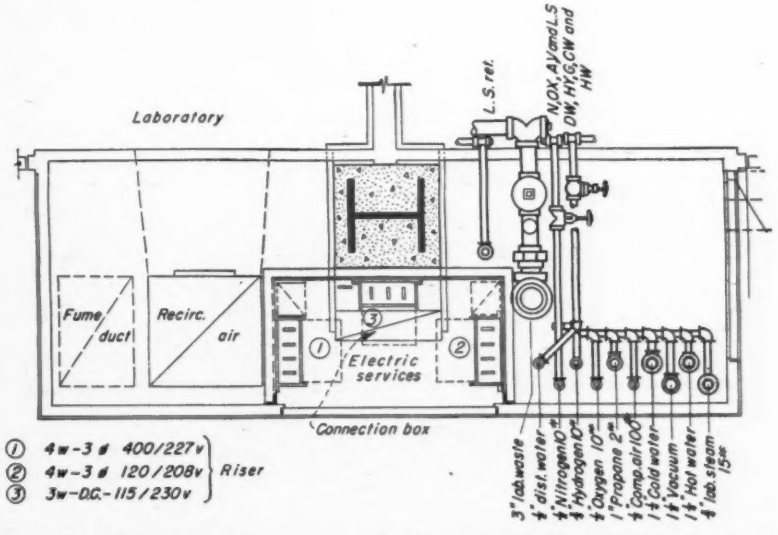
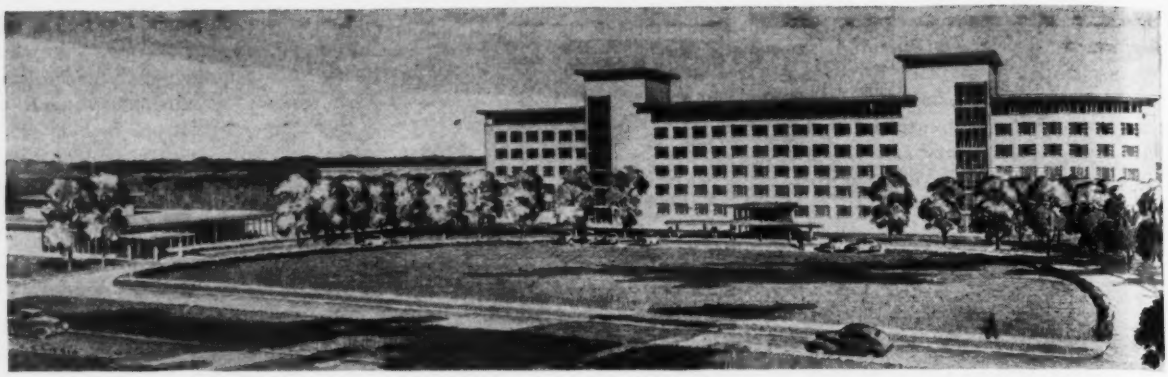


Fig. 6. Service shafts built around an H-column at a central corridor are specified for a laboratory for research on electrical equipment.



A research center for an oil company. The cafeteria with glass front at the left is one of several secondary structures.

needed for support thus minimized to offer less obstruction to ducts and other services. To eliminate the necessity for expensive spandrel waterproofing, the exterior walls are brick curtain walls free of the structure, except for anchorage to the steel frame.

Because of the cost of the foundations, it was desired to keep the number of columns in the office wing to a minimum. Thus, the auditorium floor is hung on steel angles from a heavy girder at attic level, where a deep beam is not objectionable.

A 4-ft. 2-in. module is used, and plywood ceiling forms were made this wide. The forms were butted together and the joint between sealed with adhesive tape so that upon removal of the forms no concrete fins resulted from the joint. There is, of course, the impression of the tape in the concrete, but this is very shallow and forms a regular pattern on the concrete ceiling, which is left exposed. Because of the necessary field tolerances in setting conduit and outlet boxes, the electric fixtures are so located as always to occur at the center of a panel so that any slight irregularity is not noticeable.

For another oil company where the laboratories and offices are located on opposite sides of the same corridor and it was desirable to have a module of 12 ft. for offices and 11 ft. for laboratories, of which the smallest is 22 ft. wide, the architects recommended a design that produces very different fenestration on the opposite sides of the building, a logical, but seldom used, expedient that yields an efficient plan. In this job also, the brick exterior walls are separate from the structure and freestanding.

The structure of the laboratory for a telephone company is in some respects similar to the others. One difference is that many large windows are required in the office wings, making it necessary for the brick exterior walls to be supported on the structural steel. Small bulb-angle columns were used on 5-ft. centers, thus taking up a minimum of outside wall area for the supporting members.

Beams moved to make way for risers

Services are brought up both at the outside wall and at the corridor. Since these services are not concentrated at the corridor walls, the floor space required for vertical risers does not become so large that steel H-column sections can not readily fit into the plan. On the other hand, the necessity for providing space for vertical risers at the exterior wall make it advantageous to set the floor girders one foot in from the inside face of masonry to provide this space. As mechanical plans developed, it was seen that three shafts would be necessary in each bay at the exterior wall. Since this did not fit the 6-ft. spacing of floor beams for the first floor, these beams were spaced 8 ft. on centers and their outer ends were carried on a reinforced concrete girder to distribute the load to the foundation piers and to avoid a large continuous footing under the foundation wall.

The structural design of the laboratories for a well-known manufacturer of electrical equipment posed a problem that was solved in an unusual and interesting way. The site is a hillside. One end of the building at the high end of the site extends 32 ft. below grade, and at the other end the lowest floor is at grade level, necessitating a 32-ft. high retaining wall.

To avoid very heavy construction, this wall was designed in reinforced concrete spanning between masonry buttresses 32 ft. on centers. These buttresses extend to about the top of the lower story, which is half the height of the retaining wall, so that the upper half of the wall acts as a cantilever. The steel frame of the lower two stories is of some assistance in stiffening the construction and taking the reaction, but since it is not a rigid frame, its help is limited in acting against the earth thrust, which is calculated to amount to 17,000 lb. per linear foot of wall.

The principal concern of this article has been to point out studies which have been made toward designing laboratories that are laid out in a fashion to permit the research scientist to arrange and rearrange his facilities quickly and economically to suit his ever changing needs. It should be pointed out, however, that the owners in some cases have not been completely in accord with this idea of flexibility, believing that with certain standard, fixed facilities the laboratory worker has but little need for rearrangement of facilities. After an inspection of many laboratories and in consultation with many research scientists, we believe these few owners underestimate the value of flexibility. In fact, in the preparation of occupancy plans for several laboratories, we have generally found that the arrangements for individual laboratories are changed almost daily, and are finally frozen only because of the necessity to commence construction work, and we would be greatly surprised to find the occupancy still in its present form next year.

Good Roofs Require More Than Mopping

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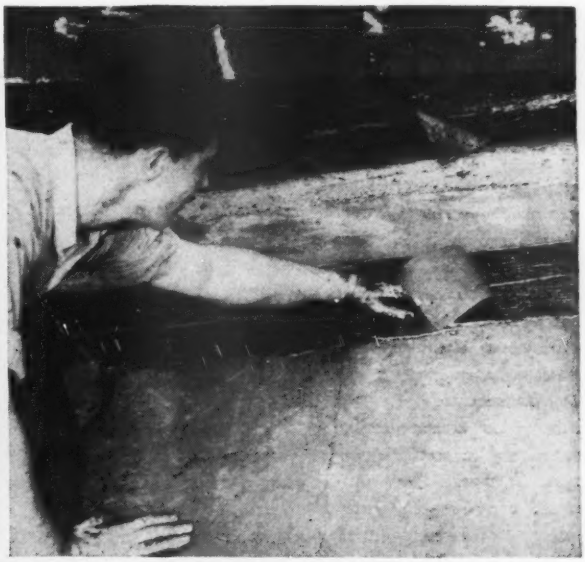
***Contents in Brief**—If built-up roofing is to function adequately, not only must roofing materials be properly applied, but in the design and construction of the roof deck, care should be exercised to provide a satisfactory surface and a drainage slope of at least 1/4 in. per ft. To prevent the felts from sliding on steep inclines in hot weather or from loosening in high winds, proper anchorage should be provided. Applying bituminous coatings and installing flashings are other operations for which there are right and wrong procedures. The materials to be used depend upon the character of the deck.*

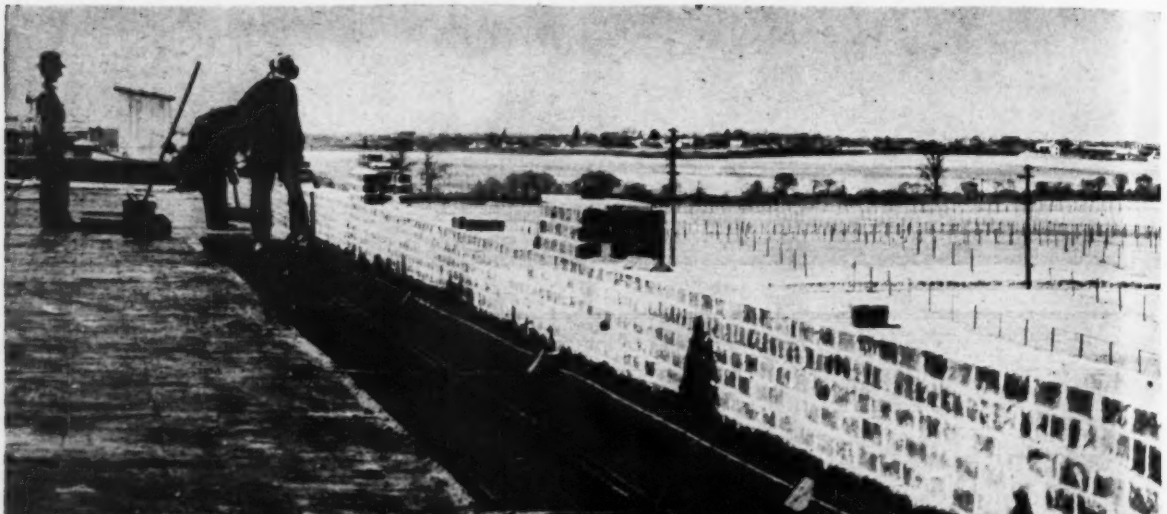
THE ROOF SURFACE of any structure is subjected to more wear by varying weather conditions over a period of years than any other part of the building. It is exposed to the beating rays of the sun, to rain, snow and ice, and at times to wind pressure of hurricane velocity. Because of these conditions, if a satisfactory application of built-up roofing is to be obtained, careful consideration should be given by the engineer or architect, the contractor, and the roofing applicator to the various factors entering into roof construction. These factors include the type of deck, the preparation of the surface of the deck, the type of roofing materials and the method of application.

There are various types of built-up roofing that may be used, depending principally on the incline of the deck surface. In the past, slag- or gravel-surfaced roofs have been generally used, but this type of roof should be confined to decks with inclines of 1 in. to 3 in. per ft., provided definite back-nailing of felts is obtained. When the incline exceeds 2 in. per ft., steep asphalt (180-200 deg. melting point) should be used for embedding the felts. Pitch-and-gravel or slag-surfaced roofs may be used on inclines up to 2 in. per ft.

The function of the slag or gravel is to act as a surface binder to hold the heavy top pouring of asphalt or pitch in a stable formation. To insure a sufficiently heavy coating of the bituminous material to embed the



After a flashing strip is applied over the cant block as weather-proofing in the angle formed by the parapet and roof deck (left), the edge of the strip is covered with asphalt saturated membrane laid in plastic bituminous cement and given a bituminous coating as illustrated at the right.



Heavily precoated felt, when applied as the first course in the cold-process method, should be embedded in cold bituminous cement. At the intersection of parapet and deck, the felts are carried over the cant block.

gravel, the hot pitch or asphalt must be poured with a dipper.

On wood decks when this type of roof is to be applied, either four or five plies of felt are used. The first two layers of felt are applied dry to act as a base and the upper plies are cemented over them with hot asphalt, if asphalt felts are used, or with hot pitch if tarred felts are used. In the case of non-combustible decks, three or four plies of felt are generally used cemented solidly to the deck surface.

Cold-process roofing

Within the last ten years, a cold-process method of application has been developed, in which heavily precoated felts are embedded in cold bituminous cement, and the top surface is protected with a heavy coating of emulsified asphalt. This type of asphalt does not crack, blister, alligator, or deteriorate, but remains stable after years of service. Slag or gravel surfacing is not required with this type of roof. The cold-process surface, providing a smooth finish, is one that can be readily maintained. It can be easily checked periodically and, when required, maintenance can be accomplished with much less expense than with a gravel type of roof.

Cold-process roofing may be applied on wood decks with inclines of from ¼ in. to 6 in. per ft., and on concrete decks with inclines of ¼ in. to 3 in. per ft., provided adequate backnailing of felts is obtained. Since a cold bituminous cement, which is not inclined to run to low levels during application, is used for embedding the felts, this type of roof is especially adaptable to decks of steep incline, because assurance is had as to the amount of bituminous cement that will be obtained between the layers of felt.

On the steeper inclines of from 2 in. to 6 in. per ft., a mineral-surfaced type of roof is likewise suitable. It consists first of an underlying course of saturated felts, over which the heavy mineral-surfaced felt is applied in two-layer construction. This mineral surfaced roofing felt is covered for 17 in. of its width with mineral granules. The remaining 19 in. is saturated but unsurfaced. When applied, one course overlaps the previous course for the 19 in. width. Backnailing of felts is required on any type of deck, and steep asphalt is used for cementing in the felts. No top surfacing is required.

Felts heavier than the No. 14 saturated felt should never be applied directly from the roll. In particular, the 53-lb. double-coated felt used with the cold-process type of application and the 55-lb. mineral-surfaced felt should be cut into convenient lengths and permitted to lie flat previous to application so as to eliminate the natural curvature of the roll. This precaution will largely help prevent subsequent buckling of the roofing felts after application.

When the heavier felts are laid in hot asphalt, the surface should either be rubbed down or broomed out immediately after application, On the other hand, in the cold process method, the brooming of the surface should take place about a half an hour after application, thereby permitting the cold cement to set.

Built-up roofing should never be applied when there is any moisture in the deck or on its surface. Even a slight amount of moisture entrapped under the roofing felts will destroy the bonding action of the bitumen, and later the moisture, expanded by the heat of the sun, will cause buckling or blistering. Hence, the application of roofing should only be carried on when the deck surface is dry. Concrete or gypsum decks should be

allowed to dry out thoroughly before any felts are applied.

A properly constructed roof deck and a properly prepared roof surface are prerequisites to satisfactory built-up roofing. Good practice suggests the following precautions:

During the winter weather, accumulated water in the process of freezing induces strains in the roofing felts, thereby over a period of years producing cracks that permit seepage of water into the deck. Adequate and proper drainage should be provided so as not to superimpose on the deck and on the roofing felts themselves the added weight of water, snow, or ice and the strains caused by freezing.

Since a major purpose of a roof is to prevent penetration of moisture, the first requisite should be to provide a slope so that any surplus water can be satisfactorily drained from the surface. While an incline of $\frac{1}{4}$ in. per ft. is the minimum that should be considered, $\frac{1}{2}$ in. is more satisfactory, for the increased slope will help to drain low spots that might develop in isolated areas.

Drainage must be considered during the construction of a roof deck. Extra care should be exercised in screeding the surface to the proper incline. When parapet walls enclose the roof deck, attention should be given to the proper location and setting of leader drains. The gutter or valleys along walls should be so well graded that ready and definite drainage to outlets is effected. It is advisable that the general contractor make a check before the actual setting of drains so that correction of the surface, if necessary, can be made to provide ready drainage to outlets and to eliminate low spots.

Miscellaneous accessories

At all valleys, at least two additional layers of felt extending 18 in. on either side of the valley line should be applied before roofing felts are laid. Over this, for additional reinforcing, a layer of asphalt-saturated membrane may be cemented in solidly before the roofing felts are applied.

At interior corners formed by vertical walls and roof deck, triangular wood cant strips, 3x3 in., should be installed to even out the abrupt angle and to close any open or irregular joints at the wall.

Backnailing of roofing felts is important. Backnailing prevents sliding of felts when exposed to continuous hot summer sun and also acts as an anchorage against the lifting action of heavy winds over the roof surface. If the slope of a concrete deck exceeds 1 in. per ft., either a finish that will permit backnailing should be used, or 1 x 2-in. wood nailing strips should be set flush with the deck on 3-ft. centers. Nailable concrete at least 1 in. thick may also be used as a finished deck surface to permit nailing.

Wood nailing strips should also be installed close against parapet walls to provide for nailing the flange of metal base flashing. Also, at open edges or roofs or at open eaves, wood edging strips should be provided to permit proper fastening of metal edging. A wood fascia strip should be provided at open edges of concrete decks so that after the roofing felts are brought down over the edge, the metal edging can be securely fastened into the vertical face of the wood strip. The nailing of the metal edge strip on the roof surface should be covered with 6-in. to 8-in. wide felt strips of the same number of plies as are used for the roof proper.

Roof deck conditions

Wood decks should be composed of well-seasoned tongue and groove boards. End joints should bear on supporting structural members so that solid nailing is obtained at all bearing points. Where first-grade, well-seasoned lumber is not available, and by necessity a second-grade or unseasoned lumber is to be used, the deck surface should be covered with at least $\frac{1}{2}$-in. or 1-in. thick rigid roof insulation firmly secured to the roof deck prior to the application of the built-up roofing. Cracks or joint openings between roof boards should be covered with a thin-gage strip of metal solidly nailed to the deck before the roofing is applied.

Where precast concrete or precast gypsum slabs are used as the roof deck, all end joints should bear solidly on supporting structural members or else a ship-lap or tongue-and-groove joint should be provided. If the edge of one unit rides up above that of an adjacent unit, a smooth, even application of roofing cannot be obtained. Should the slab eventually settle, due to unevenness in the setting, the resultant strain on the roofing felts will cause them to crack. It is therefore important that when precast slab decks are used, a smooth, plane roof surface be provided.

The holding power of nails into either precast or poured gypsum is not equal to that with wood decks. Therefore, 1 x 2-in. wood nailing strips should be provided and set flush with the deck surface on 3-ft. centers by the general contractor so

Insulation boards being cemented to roof deck. The use of insulation is advisable in some cases to minimize effect of heat originating inside buildings.

that in addition to being cemented to the deck, the roofing felts can be adequately backnailed.

In certain types of buildings, such as power plants, a very high temperature may build up under precast roof decks. This heat will continue to rise and eventually seep through the joints between the slabs, causing pressure to be exerted on the under side of the felts. This pressure will weaken the bond of the felts with the deck and eventually produce buckling. The addition of a sufficient thickness of rigid roof insulation over the deck before the built-up roofing is applied will minimize or prevent this condition. The installation of ventilators should also be considered where high temperatures are anticipated.

Suggestions concerning flashings

The flashing that forms the connection between the built-up roof and the parapet walls is very important. There are several types, but copper base and cap flashings have been found most satisfactory when properly applied.

Before copper base flashing is set, it is good practice to apply a backer course of at least two layers of the saturated felt or one layer of coated felt in the angle formed by roof deck and vertical wall. This backer course acts as an additional weatherproofing at the joint between wall and roof and as a protection against any condensation that might occur between the inner surface of the copper base flashing and the wall. The felts should be applied in hot steep asphalt or in cold plastic fibrated cement so that they extend up the parapet at least 8 in. and out over the cant strip on the roofing felts 6 in. They should then be coated with hot asphalt or the cold plastic cement before copper base flashing is actually installed.

Copper base and cap flashing preferably should be applied with interlocking laps so as to allow for expansion and contraction. Interlocking laps also provide better weather protection. In fastening copper flashing or edging, it is advisable to use copper cleats so as to allow for proper expansion and contraction.

Copper cap flashings carried through the wall with a ½-in. flange extending down along the outer face of the wall are strongly recommended. This type of flashing prevents infiltration of moisture through the top of the parapet wall into the interior of the building at the wall line.

Built-up base flashings are composed of various layers or combinations of felt that are protected with an outer layer of mineral-surfaced roofing, or with a smooth-surfaced roofing coated with emulsified asphalt or with a heavy surface coating of plastic fibrated cement. Since there are a number of layers of felt built up in this way against a vertical surface, there is a tendency for them to sag unless properly secured by nailing at the top. Therefore, a built-up flashing must be fastened on not over 12-in. centers with nails and large flat caps driven into the mortar joints of brick walls or into a special nailing strip embedded flush with the surface of concrete walls. The nailing line should then be covered with a 4-in. strip of felt or saturated membrane embedded in and coated over with plastic cement, and the copper cap flashing should then be brought down over the top of the base flashing at least 4 in.

Where raggle blocks are used, it is most important that the felts be nailed into the top of the cant surface close to the lip of the raggle opening (a narrow groove in a masonry surface for receiving the edge of a flashing). If this nailing is not obtained, the felts will eventually slide from the raggle and permit water to seep through the flashing into the deck. In addition to nailing, a satisfactory type of calking cement should be applied to the raggle joint after the flashing felt has been set.

Copper or lead flashing or metal pitch pockets should always be specified around vent pipes, stacks or similar projections. In addition, any steel struts or structural members projecting above the roof should likewise be set in metal pitch pockets. A built-up type of flashing is not suitable around chimneys or smokestacks, which should be properly flashed with copper base and cap flashing.

Base and counter flashings are generally installed to extend 10 in. or 12 in. above the roof line. If the parapet wall extends some distance above this height and a wall coating or flashing is desired above the base flashing, the wall may be surfaced with a protective coating of at least 3 gal. of emulsified asphalt per 100 sq. ft., applied in two coats directly to the wall surface. As an alternative, a layer of felt or membrane laid in and coated with cold plastic cement may be carried over the top of the wall, preferably before the coping is applied, and brought down the far side to cover the top of the base flashing at least 6 in.

Felts laid in an adhesive form the base course of built-up roofing over an insulation-board deck, which has been cemented to the roof surface.

Guides to Improved Framed Walls for Houses

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***Contents in Brief**—Tests on panels of wood-frame walls for dwellings indicate the superiority of diagonal sheathing over horizontal, of plywood sheathing fastened by gluing over other types of sheathing and of let-in braces over herringbone and cut-in braces. While siding alone is not effective in providing strength and rigidity, the tests show that addition of siding to a sheathed wall is. For panels unpierced by openings, the use of wood lath and plaster provides more rigidity than braced walls with lumber sheathing.*

MANY factors influence the strength and rigidity of a wood-frame wall subjected to end thrust and other racking forces—the size and location of openings in the wall, the use of sheathing, the type of bracing, if any, and the moisture content of the framing and sheathing. These factors have been studied at the Forest Products Laboratory to provide data that will permit a logical selection of construction methods. A summary of the more important facts disclosed points the way to improved design of frame walls for houses.

The test panels from which the data were obtained were, in general, 9 ft. high by 14 ft. long, a size representative of story heights and of sufficient length to approximate practical conditions. The panel frames, which were mostly of southern yellow pine, consisted of 2x4 upper and lower plates and 2x4 studs, spaced 16 in. on center, held in position by two nails through the plates into their ends. Each end post consisted of three 2x4 studs nailed to form a channel shape.

To these basic frames were added various types of sheathing and bracing for the study of the variables involved. In some cases, openings in the form of a double 28-in. window and a 3x7-ft. door were provided.

In the test procedure developed, a horizontal load acting parallel to the length of the panel was applied at one upper corner, with the opposite lower corner bearing against a hold-back stirrup (Fig. 1). The resistance to lateral buckling normally provided by the upper floor system was supplied, in test, by a heavy timber to which the upper plate was attached, and the overturning tendency, resisted in service by upper-story and roof loads, was resisted in test by hold-down rods. Long pin-connected tie bars at the ends of the panel simulated the aligning action of cross walls. Cables attached to the movable head of the testing machine and passing around sheaves permitted horizontal application of load to the panel.

Rigidity was measured by the load at some given movement of the upper plate with respect to the lower, generally 0.5 in. In certain cases, such as frames sheathed with plywood glued to the frame, the stiffness was so great that it was necessary to use loads at smaller deflections. The strength of a panel was taken as the maximum load sustained during test.

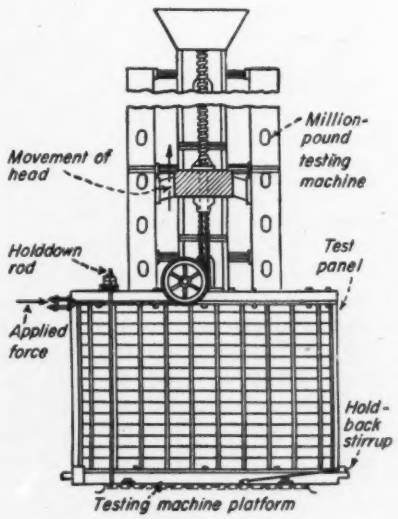

Fig. 1. Diagrammatic sketch of set-up for end thrust test of frame wall.

A frame covered with sheathing would constitute the practical minimum of shelter afforded by a wall. Since the simplest and most common type is horizontal sheathing, a frame wall covered with square-edged horizontally placed sheathing of 1x8 lumber, fastened with two 8d nails at each stud crossing (without openings) has been taken as the standard of comparison. The results of tests on panels of other kinds are expressed as rigidity and strength factors, which are the ratios of the rigidity and strength of the panel in question to the same properties of the standard. The test results are summarized in Fig. 2 to 8.

Diagonal sheathing effective

In the case of horizontal sheathing, the principal resistance to thrust is afforded by the reaction couples of each pair of nails at the stud crossing. Although friction between the boards and studs and though the couples set up as the edges of the boards come into contact offer some resistance, the slightest shrinkage almost entirely eliminates the friction, and the couples between the edges of the boards are unimportant except for relatively large distortions. A horizontally sheathed wall, like any other untriangulated framework, gets its rigidity from the fixity of the joints.

With the sheathing applied diagonally, there is triangulation in the wall, and the nails offer far more resistance to distortion. Tests of panels without openings and with the sheathing boards in tension showed the diagonally sheathed wall to be about four times as rigid and more than eight times as strong as a horizontally sheathed wall; a single test

Effect of Sheathing (No Openings)	Relative rigidity	Relative strength
A — 2 8d Nails per stud crossing	1.0	1.0
B — 2 8d Nails per stud crossing	4.3	8*
C — 8d Nails spaced 3 inches at vertical edges, 6 inches on intermediate studs, 5½ inches on plates	3.0	3.8
D — 8d Nails spaced 6 inches on all edges of plywood, 12 inches on intermediate studs	4.8	9*
E — Glued to frame	24*	9*
F — 6d Nails spaced 5 inches on all edges of plywood, 10 inches on intermediate studs	4.2	5.2
G — 6d Nails spaced 2½ inches on all edges of plywood, 5 inches on intermediate studs	5.9	7.0
H — Glued to frame	14.4	8.6

Fig. 2. Effect of sheathing on frame walls having no openings. A and B, 1x8-in. lumber; C, 29/32-in. fiberboard; D and E, ⅜-in. plywood; F, G and H, ¼-in. thick plywood.

Effect of Sheathing (Window and Door Openings)	Relative rigidity	Relative strength
A — 2 8d Nails per stud crossing	1.0	1.0
B — 2 8d Nails per stud crossing	0.7	0.8
C — 2 8d Nails per stud crossing	1.4	4.0
D — 2 8d Nails per stud crossing	1.0	1.3
E — 8d Nails spaced 3 inches at all vertical edges, 6 inches on intermediate studs, 5½ inches on plates. Fiberboard sawed out for openings	1.5	1.6
F — Nailing as above. Fiberboard used in continuous sheets with nailing stubs above and below openings	1.6	2.1
G — 6d Nails spaced 5 inches at all plywood edges and 10 inches at intermediate studs	2.0	2.8
H — Glued to frame	3.7	4.0

Fig. 3. Effect of sheathing on frame walls with window and door openings. A, B, C and D, 1x8-in. lumber; E and F, 29/32-in. thick fiberboard; G. & H. ¼-in. thick plywood.

Effect of Bracing	Relative rigidity	Relative strength
B — 2 8d Nails per stud crossing 2 by 4-inch herringbone bracing	1.3	1.1
C — 2 8d Nails per stud crossing 2 by 4-inch cut-in braces	1.6	1.4
D — 2 8d Nails per stud crossing 1 by 4-inch let-in braces	2.6	3.6
E — 2 8d Nails per stud crossing 1 by 4-inch let-in braces	4.2	3.5
F — 2 8d Nails per stud crossing 1 by 4-inch let-in braces Window and door openings	1.5	2.2
G — Two straps nailed to studs with one nail per stud Sheathing covers straps	2.1	1.5
H — Two straps nailed to sheathing with two nails per board. Straps outside sheathing	1.9	1.4
J — Seven straps nailed to sheathing with two nails per board; straps outside sheathing	3.3	2.9
K — Two straps each corner nailed to sheathing with two nails per board	1.4	1.3

Fig. 4. Influence of bracing on rigidity and strength of frame walls sheathed with 1x8-in. boards, with and without window and door openings. Let-in bracing gave best results.

with the boards in compression showed the rigidity to be about seven times and the strength nearly eight times that of the horizontally sheathed wall. It is probable that certain conditions of the tests were influential in producing these differences in rigidity and strength for the two types of stress and that, in actual practice, the differences would not be significant. (Fig. 2).

A wall without openings and sheathed with fiberboard about $\frac{29}{32}$ in. thick and weighing about 19.4 lb. per cu. ft. (based on oven-dry weight and air-dry volume), was three times as stiff and nearly four times as strong as the reference wall. However, when large sheets of fiberboard were sawed to fit around openings, the material failed at the reentrant angles at relatively low loads (Fig. 3). By applying the fiberboard in continuous sheets without reentrant angles and by inserting 2x4 studs for nailing of the small sheets above the openings, the same rigidity as before was maintained for small deformations, and a considerable increase in rigidity was obtained for the larger distortions. The strength was increased about 30 percent.

Plywood sheathing contributes considerable strength and rigidity to a frame wall. When glued to the frame, ¼-in. plywood gave rigidity and strength factors of about 14.4 and 8.6, respectively, indicating the importance of the means of attachment to the frame. This will be discussed more fully later.

Effect of bracing evaluated

To make horizontally sheathed walls more rigid, various types of bracing have been used. Three types —herringbone or bridge bracing, cut-in braces, and let-in braces—were tested, and the possibility of bracing with thin metal strapping was also studied (Fig. 4).

Herringbone bracing consists of short pieces fitted between the studs at a small angle with the horizontal and about midway between the upper and lower plates, with the braces sloping oppositely in adjacent stud spaces. Wall stiffness was only slightly increased and strength practically unaffected by the use of such bracing, despite the fact that this type has reportedly been advocated for use in tornado areas.

Cut-in braces consist of 2x4 diagonals fitted between the studs at an angle of about 45 to 60 deg. with the horizontal and in a line from the upper to the lower plates. Generally, two diagonal lines, inclined in opposite directions, are used. Obviously, only the one in compression would be effective, since the pieces of the one in tension would tend to pull away from the studs. Even the brace in compression would not be expected to be fully effective until some distortion of the wall had occurred, unless the braces fit well against the studs.

The tests showed increased rigidity and strength for a panel with cut-in braces (tension and compression) added at an angle of about 60 deg. with the horizontal.

Let-in braces are continuous braces set into notches in the edges of the studs. Whether in tension or compression, they act immediately and effectively when load is applied. The tests indicated that 1x4 braces let into the studs at the same angle as the cut-in braces tested gave rigidity and strength factors of 2.6 and 3.6, respectively, as compared with 1.6 and 1.4 for the cut-in braces. A somewhat different arrangement of the let-in braces afforded even more stiffness.

A few tests were made of horizon-

Effect of Siding	Relative rigidity	Relative strength
A — 2 8d Nails per stud crossing	1.0	1.0
B — ½ by 6-inch siding, 7d siding nails	0.7	0.5
B — ¾ by 8-inch siding, 8d siding nails	1.0	0.8
C — ½ by 6-inch siding, 7d siding nails	3.2	3.3
C — ¾ by 8-inch siding, 8d siding nails	3.1	3.7
D — ½ by 6-inch bevel siding	1.1	1.3
E — ½ by 6-inch bevel siding	2.0	3.3
F — ½ by 6-inch bevel siding	3.3	5.4
G — 1 by 4-inch let-in braces and ½ by 6-inch bevel siding	2.7	3.4

Fig. 5. Effect of siding. A, D, E, F and G, 1x8-in. sheathing; B, bevel siding only; C and D, bevel siding and 1x8-in. let-in braces; E, sheathing tested in compression and F in tension.

Effect of Fastenings	Relative rigidity	Relative strength
A — 2 8d Nails per stud crossing	1.0	1.0
A — 3 8d Nails per stud crossing	1.0	0.9
A — 4 8d Nails per stud crossing	1.4	1.4
B — 2 10d Nails per stud crossing	1.5	1.4
B — 2 12d Nails per stud crossing	1.3	1.1
C — 2 8d Nails per stud crossing	4.3	8+
C — 3 8d Nails per stud crossing	5.2	8+
C — 4 8d Nails per stud crossing	7.5	8+
D — 2 8d Nails per stud crossing	4.3	8+
D — 2 10d Nails per stud crossing	5.1	8+
E — 1 by 4-inch let-in bracing	3.7	3.7
E — Same, except sheathing nailed to bracing with 6 8d nails per space	5.6	5.8
F — 8d Nails spaced 3 inches at vertical edge, 6 inches on intermediate studs, 5⅓ inches on plates	3.0	3.8
F — Double nailing	4.5	6.1
G — 8d Nails spaced 3 inches at all vertical edges, 6 inches on intermediate studs, 5⅓ inches on plates, nailing stubs above and below openings	1.6	2.1
G — Double nailing	1.7	2.6
H — 6d Nails spaced 5 inches on all edges of plywood, 10 inches on intermediate studs	4.2	5.2
H — Double nailing	5.9	7.0
H — Gluing	14.4	5.6

Fig. 6. Influence of fastenings. A, B, C and D, 1x8-in. sheathing; E, 1x8-in. siding with 1x4-in. let-in bracing; F and G, 29/32-in. thick fiberboard; H, ¼-in. thick plywood.

Effect of Plaster	Relative rigidity	Relative strength
A — 2 8d Nails per stud crossing	1.0	1.0
B — No sheathing or bracing	7.2	4.4
C — 2 8d Nails per stud crossing	7.9	5.6
D — 2 8d Nails per stud crossing	9.2	7.8
E — No sheathing or bracing	2.3	1.6
F — 2 8d Nails per stud crossing	2.4	2.2
G — 2 8d Nails per stud crossing	2.8	4.4
H — 1 by 4-inch let-in braces	4.1	3.6

Fig. 7. Effect of plaster. A, 1x8-in. sheathing; B and E, plaster on wood lath only; C, D, F, G and H, plaster, wood lath, and 1x8-in. sheathing on opposite side of frame from plaster.

tally sheathed panels braced with metal strapping. For this purpose, black-iron straps having a tensile strength of 1,400 lb., 1.025 in. wide by 0.03 in. thick, with $\frac{9}{64}$-in. holes punched at about 4-in. intervals along the centerline, were attached to the wall with galvanized large-head roofing nails one inch long. Even with seven straps per panel, however, the frame has neither the strength nor the rigidity of a diagonally sheathed wall or of a horizontally sheathed wall with let-in braces.

To determine the contribution of siding to the strength and rigidity of a frame wall, tests were made on bevel siding used alone, as well as with sheathing and with bracing (Fig. 5). The results indicate that siding alone is not effective, but with let-in braces both properties are increased to a marked degree. Siding also improves strength and rigidity when added to horizontally and diagonally sheathed walls with openings and even when added to horizontally sheathed panels with let-in braces.

In contrast with siding, wood lath and plaster when used alone produced a more rigid panel, if unpierced by openings, than did any type of lumber sheathing or even bracing in conjunction with lumber sheathing (Fig. 7). In the case of plastered panels with openings, concentration of stress at the corners of the openings resulted in the development of plaster cracks at very low loads and small deformations, reducing both rigidity and strength considerably as compared with an unpierced panel. However, stiffness was still slightly more than twice, and strength somewhat less than twice, that of a horizontally sheathed panel. When plaster is combined with diagonal sheathing or with horizontal sheathing and let-in braces, both strength and rigidity are markedly increased.

Thus, plaster on wood lath may furnish all the rigidity necessary for most purposes under normal conditions. As the plaster begins to crack from shrinkage, settlement or other causes, however, the rigidity of the sheathing comes more and more into play, so that in violent winds or earthquake, it is the sheathing, or sheathing and bracing, that become all important in preventing complete destruction. This is especially true in the case of walls with openings. Further, adequate sheathing and bracing in conjunction with plaster may be expected to assist materially in limiting annoying plaster cracks and the consequent maintenance.

Methods of fastening studied

When the number of nails in a horizontally sheathed wall is increased from two to three at each stud crossing, there is no increase in the reaction couples, and therefore, no increase in rigidity or strength (Fig. 6). With four nails at each crossing, there is a small increase in the reaction couples. This, together with a slight increase in friction between sheathing boards and studs, results in an increase in rigidity of about 40 percent over that for walls with either two or three nails per crossing.

With diagonal sheathing, increasing the number of nails at each stud crossing produces large increases in stiffness. The stiffness of a diagonally sheathed wall is, however, large enough with two nails so that it is questionable whether the increased stiffness imparted by additional nails is needed. Doubling the recommended nailing in panels sheathed in

fiberboard also increases both strength and rigidity.

The tests indicated that bending of the nails is a dominant factor. Larger nails, therefore, with greater resistance to bending, were tested. It was found that 10d and 12d nails, which have equal diameters, increased the stiffness of a horizontally sheathed panel about 50 percent and the maximum load about 40 percent over that obtained with 8d nails, which are of smaller diameter. For a diagonally sheathed panel, the stiffness was increased, by the use of 10d nails, about 20 percent over that for a panel using 8d nails.

As mentioned previously, gluing of plywood sheathing to the studs greatly increases the rigidity of the panel. The increment is so large that the tests were not carried to deformations comparable with those of other panels, and rigidity factors are not strictly proportionate. However, if the test results for glued plywood are compared with those for nailed plywood, it may be concluded that the inherent rigidity of the plywood is developed only in a measure commensurate with the adequacy of its attachment to the frame. This is borne out by the effect of doubling the number of nails used in attaching ¼-in. plywood, in which case the rigidity factor is increased from 4.2 to 5.9 and the strength from 5.2 to 7.0.

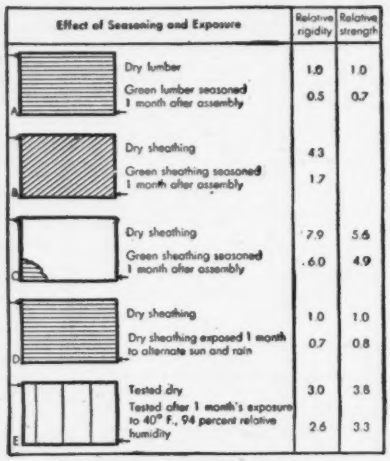

Fig. 8. Influence of seasoning and exposure of sheathing. A, B and D, 1x8-in. wood sheathing; C, plaster, wood lath, 1x8-in. wood sheathing; E, 29/32-in. thick fiberboard.

It is probable that, for most cases, rigidity requirements would not justify the exacting technique required for good gluing of plywood sheathing to the frame. The test results, however, point the way to a method of achieving great rigidity in locations or for applications where unusual requirements must be satisfied.

Tests were also made to determine the effect of using unseasoned wood (Fig. 8). Panels either horizontally or diagonally sheathed were made of green lumber and allowed to season indoors for one month before being tested. They were then found to be about one-half as rigid as similar panels made of seasoned lumber and tested immediately. The reduction for a plastered wall with green sheathing was somewhat less severe but was still marked.

The effect of long-time exposure to wind impact, street traffic and other vibrating influences was explored. After as many as 1,000,000 cycles of vibration designed to produce deflections within 50 or 75 percent of the elastic limit, panels showed no reduction in strength and stiffness as compared with similar panels not vibrated.

As a result of these tests, the advantages of using seasoned lumber, diagonal sheathing and let-in bracing are clear. Minimizing of cracked plaster and out-of-square door and window frames through the use of these simple methods of stiffening and strengthening the structure will generally reduce maintenance costs enough to far outweigh the initial saving from the use of less sound construction.

Aluminum Building Wires Proposed as Substitute for Scarce Copper

Because of post-war shortages in the copper supply, the use of aluminum wire as conductors for insulated wires and cables employed under the conditions generally covered by the National Electrical Code has been suggested. Sections 1109 and 3107 of the forthcoming 1946 edition of the code refer to the lower conductivity of aluminum. However, none of the provisions of the code as to dimensions of wires, allowable currents, temperature ratings of insulation, etc., were intended to be applied to products with conductors other than of copper. The Underwriters' Laboratories, Inc., Standard for Rubber-Covered Wires and Cables also assumes that conductors will be of copper.

The use of aluminum requires special consideration because of certain differences in properties and performances as compared to copper. The following notes make brief mention of some of these.

Aluminum has only 84 percent the conductivity of copper. For the conductors of branch circuits that are fused at 15 amp., No. 12 Awg aluminum wire should be used, instead of No. 14. On this account larger sizes of raceways may be necessary for the same number of conductors.

Most appliances and devices have copper or brass terminals for wire connections. Because of the electrolytic effect, aluminum conductors secured to such terminals may be severely or completely corroded by such contact between these dissimilar metals.

At equipment terminals that do not employ binding screws, electrical connection is generally by soldering lugs or by pressure connectors. At present such terminal fittings are not generally available except in copper or brass. In moist atmospheres, the electrolytic effect may develop eventually with connections of these types unless inserts of a "neutral" metal such as zinc, or other special methods are used. The mechanical and electrical reliability of such connections depend upon practices and workmanship not as yet generally employed. Dressing connections with coatings to exclude air from contact areas, however, may not prove to be a permanent measure.

Suitable solders and soldering fluxes for joints between aluminum conductors or between such conductors and terminal fittings of other metals are not commonly available and the "know-how" in the use of those solders that are available is limited.

Practical Methods to Avoid Cracked Walls

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***Contents in Brief**—Many faults in masonry walls are the result of oversights in construction, such as failure to shore freestanding walls while they are being built or to provide proper bearing and anchorage for floor slabs and beams. Sometimes bearing walls are subject to excessive chasing for pipe installations or to recessing prior to placing of facing brick, both of which are dangerous practices that should be avoided.*

UNSIGHTLY cracks in masonry walls, and sometimes even complete collapse, may be traced to negligent construction practices. Faults may occur even though the requirements of building codes are satisfied. Codes generally specify thickness of wall with respect to height, allowable bearing stresses and type of bond and limit the horizontal area of openings in bearing walls. But that these provisions are insufficient to guarantee safe walls was pointed out by Elwin E. Seelye ("Brickwork As Seen by the Engineer," *ENR*, Nov. 20, 1941, vol. p. 724). His article indicated the danger of merely selecting wall sizes from the rule-of-thumb tables found in building codes without investigating the stability and strength of wall details and laid down principles of design.

Most building codes limit the unsupported height of a brick wall to eighteen times the wall thickness. This provision usually yields satisfactory results in completed buildings, in which the walls are supported laterally at the top as well as at the bottom. However, if, as a wall is erected, it stands as a vertical cantilever without benefit of the lateral support of beams or slabs at the top, it is a relatively unstable structure in a wind storm. At least four cases are known in which unsupported walls have been blown down by wind, in some instances causing damage far beyond the value of the wall itself. If a wall is under construction and a delay in delivery of steel is expected, it should be shored to protect the investment of the contractor as well as of the owner.

One of the more frequent causes of cracks in masonry bearing walls is neglect of bending moment induced by the supported members. An analysis of the manner in which load is applied to a wall should always be made. Most walls designed in accordance with ordinary code specifications will furnish sufficient resistance to bending, but if the floor load is heavy, the span long or the wall has a large percentage of openings, cracks may appear.

The resistance to bending of walls that carry concrete beams or slabs

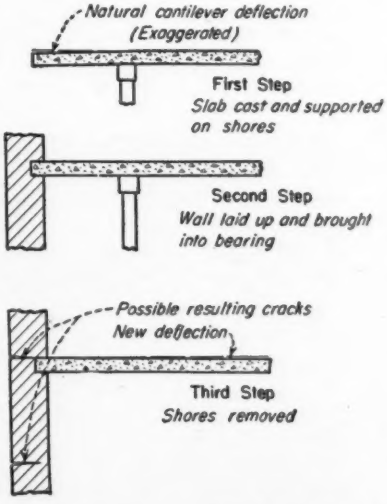

Fig. 1. The danger of bringing the end of a slab into bearing on a wall after the concrete has hardened lies in the bending moments induced in the wall by the changed end slope of the slab.

should be at least $WL/48$ above and below the point of application, where W is the total load and L the span of the member. Otherwise, regardless of whether the wall fulfills code requirements or not, unsightly cracks may be developed.

Shortages of materials and labor may be blamed for a particularly vicious construction method that is used too often. In at least one case, this practice was a contributing cause of the collapse of a wall and the floor that it supported. Lacking bricks to complete a bearing wall, the contractor cast his floor slabs on shores, then attempted to bring the wall into good bearing afterward. The end of the slab, originally acting as a cantilever beyond the last shore, became a supported end when bearing was established and the shores were removed. Under these circumstances, the end sloped below the horizontal as contrasted with its former slope above the horizontal (Fig. 1). The moment induced in the wall, together with the imperfect bearing, led to the collapse. This erection procedure is more prevalent than most engineers realize.

In recent years much discussion has been devoted to the tendency of brick bearing walls supporting flat concrete floors to crack in a horizontal plane at the corners of floor and roof lines, being worse at the upper floors and worst of all at the roof. Various reasons have been advanced for this so-called "curling" of the floors, and therefore various cures have been suggested. One of the most likely reasons offered is that a strip of floor diagonally across a corner several feet inside the building acts as a fulcrum about which the floor deflects and lifts the corner (Fig. 2).

If this is the correct explanation, the obvious solution is to anchor the

corner to the slabs below either by means of rods in the brickwork or by reinforced concrete columns. Many engineers thicken the edge of the slab along the wall to double the normal thickness.

With respect to the supporting of structural steel members, there are two conditions worthy of note. First, in wall-bearing construction, steel beams should rest on bearing plates that are bedded on brick pads and not on backed-up tile or other low-bearing-value units; otherwise serious cracks may develop. Secondly, steel beams should be properly anchored to the wall.

About 30 years ago, the main bearing wall of a theater in Washington collapsed through lack of adequate anchorage of roof trusses. During the years they were in place, the trusses had expanded and pushed the wall outward, and then contracted and slipped down the wall until their bearing had been reduced to point of failure. Even a comparatively light anchorage would have prevented this.

A method that will not only avoid cracks due to curling but that will also strengthen the wall to resist wind and earthquake pressure, provide adequate resistance to bending and increase stability is to reinforce the wall, both horizontally and vertically, with $\frac{3}{8}$-in. reinforcing rods. Although, in general, building codes do not make any allowance for use of such reinforcement, and too little is known as to how much this construction adds to the cost of the wall, the added strength is well worth the extra money.

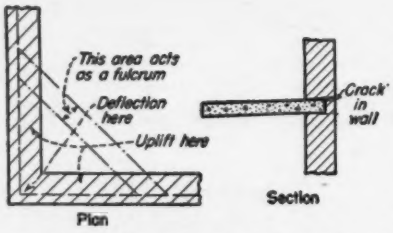

Fig. 2. Horizontal cracks in walls at corners are sometimes caused by curling of roof or floor slabs.

Another practice that should be avoided is that of cutting into bearing walls or of building in chases for pipes and other accessories. The conditions shown in Fig. 3 were found in the first story of a two-story bearing wall on state work. On another job, a 12-in. bearing wall had a 4-in. deep horizontal chase cut into it for a distance of over 30 ft.

Cracks caused by recesses in walls

Even in a wall where the bearing stresses are comparatively low, the presence of a chase can cause unsightly cracking. In one case, a 4-ft. wide pier cracked when it was divided by a chase into two piers, which were roughly 1 and 3 ft. wide, respectively. Each pier carried about the same total load—not enough to endanger the safety of the narrower of the two, but sufficient to cause a differential shortening of the two piers under load. This difference in height caused the wall to crack on the face opposite the chase.

In some buildings, glazed brick or glazed hollow tile is laid integrally to form part of the required thickness of a bearing wall. Theoretically, this is good, economical construction, but unless the work is properly supervised it frequently does not result well in practice. The main difficulty arises from the fact that glazed brick, being a finish material, is often installed after the rough construction work has been finished, the common and face brick laid, the steel erected, and the concrete slabs cast. Thus, during the period of construction, the wall must stand without having its full thickness.

Undoubtedly, most walls are subjected to much greater stresses during construction than they will ever be called upon to bear in a completed structure. Therefore, bearing walls should be built to full thickness before the floor beams and slabs are placed. One example of a violation of this principle is that of a 12-in. auditorium wall, with an unsupported height of 19 ft., that was recessed to form an 8-in. wall through the lower 9 ft. to allow glazed brick wainscot to be installed (Fig. 4 left). Another example is that of the 12-in. brick wall shown in Fig. 4 right. It was to be built with two faces of glazed brick held to a central 4-in. brick core by metal ties. During construction, the 4-in. core was erected to full height and a beam with an ultimate reaction of 20,000 lb. placed on it.

There is no good reason why glazed brick cannot be laid up integrally with the wall of which it forms a

Fig. 3. Examples of improper cutting of chases in the first story of a two-story bearing wall. Bad cracking is inevitable

part. It is cheaper, of course, to lay the finish material after the core, but good construction usually costs more than shoddy. If glazed headers are not desirable, alternate courses of full blocks and "soaps" may be used. This is, at least, better than galvanized wall ties. All sorts of arguments have been advanced by contractors as to why this cannot be done, but the fact remains that it has been done satisfactorily on many jobs. By proper specification, it is possible to avoid getting an 8-in. bearing wall with 4 in. of facing instead of a 12-in. bearing wall.

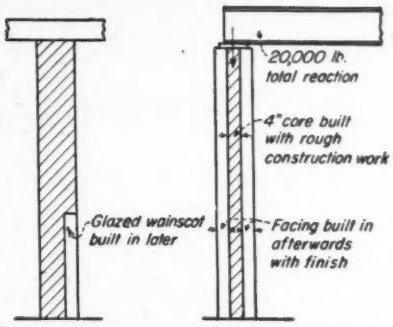
20,000 lb. total reaction
4" core built with rough construction work
Glazed wainscot built in later
Facing built in afterwards with finish

Fig. 4. Abuses observed in construction of glazed brick bearing walls. Left, 4-in. wide, 9-ft. high recess left for wainscoting in 19-ft. high auditorium wall. Right, 4-in. core supporting loaded beam during construction.

Seepage disintegrates walls

Perhaps the most vulnerable point in the entire wall of a building is the parapet. There has been more than one parapet that, after having been in place only a few years, has curled outward until in a comparatively short time it had to be taken down and completely rebuilt. Instead of being built of seconds, bats and tailings, as is so frequently done, parapets should be built of the best brick, using the best mortar and the best workmanship on the job. Impervious copings with continuous drips and waterproof joints should be used, and the wall should have through flashing immediately under the coping running to at least 1 in. from the face of the wall.

Disintegration of walls can frequently be traced to penetration of moisture. The principal points of entry are at window and door sills, copings, parapets, recessed panels and other points where water can seep through horizontal surfaces rather than through the vertical faces of the brick. If the bed surface of the brick itself is too porous and is not properly soaked before laying, the brick is apt to absorb water from the mortar and prevent proper adhesion. On the other hand, a bed surface that is too dense will not develop proper bond to the mortar.

A definite measure of the ability of a brick to bond may be made by immersing a dry brick on its bed surface to a depth of $\frac{1}{8}$ in. in water for a period of one minute. The strongest joints will result when the absorption is over 10 grams and less than 40 grams.

The absorptive qualities of the face of the brick have almost nothing to do with the water tightness of the wall. It stands to reason, then, that it is the composition of the mortar itself that is important. For a time, maximum crushing strength as developed by a straight cement mortar was very much in favor, but now a 1:1:6 mortar (one part lime, one part cement, and six parts sand) has again become popular because of its better workability and greater elasticity, which result in better bond.

Window and door sills should be designed so that simple, practical mortar joints may be laid against them. Window sills should project at least 2 in. and have continuous drips. Brick sills should have a slope outward of 2 in. per ft. and should have a continuous metal or waterproof flashing beneath. Stone window sills, if jointed, should be flashed under the joints.

Performance Standards Building Code Under Preparation in England

Differing somewhat from American efforts toward modernizing building codes, a contemporary British attempt aims simply at a "statement of good practice," for use as a national model. This was pointed out in an article, "Preparation of Building Codes in England," by Colin Lucas, British Commonwealth Scientific Office, New York City, in *Tomorrow's Town*, a publication of the National Committee on Housing. The code is being prepared under the auspices of a government-sponsored committee by qualified experts with the aid of architects and engineers.

To distinguish between performance standards and specific techniques, the code is divided into two parts. Part I, "Code of Functional Requirements", consists of 11 chapters, dealing with light and air, space, noise, fire, loading, weather protection, services, heating, heat insulation, corrosion, dirt and vermin, and acoustics. These standards form the basis for the recommendations of Part II, "General Series Codes," which deals with materials and methods. Part II is divided into three main headings: 1. Structure, covering foundations, frame, walls, floors and roofs; 2. Finishes, including paints, plaster and floor coverings; and 3. Installations, covering sanitation, drainage, water supply, utilities and mechanical equipment.

Mr. Lucas recommends the following rules as a start toward a code of good practice in code drafting:

1. The aim of a code should be to open the way for new technical developments, and to make them available to the public.
2. The difference between performance standards and specific techniques should be kept in mind at every stage of code drafting.
3. Special techniques may be codified, but should never be made obligatory; performance standards should be codified and should be obligatory, but machinery should exist for their review.
4. Construction types should not be restricted by zoning rules; theoretically codes should permit any building to be erected anywhere, provided it satisfied the code's requirements.
5. The difference between scientific fact, traditional experience and opinion should be kept in mind when standards are being formulated. Wherever possible, standards should be based on the first, but the second and third cannot be discounted.

Why "Slab-Band" Floors Are Economical

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***Editor's Note**—In the description of the floor system of the New Tripler General Hospital in Oahu Island (ENR July 12, 1945, vol. p. 46), it was said that the designer believed that wide, shallow concrete beams were practical and economical. This type of construction had also been described in ENR Oct. 19, 1944, vol. p. 510. Mr. Severud, the designer, was asked if he could substantiate the advantages of "slab-band" construction with facts and figures, and the following is his reply.*

EXCEPT IN RARE CASES, slab-and-narrow-beam concrete construction is outmoded. Providing a distribution of material more in conformity with the critical stresses, "slab bands" are more economical and have in addition other advantages not easily evaluated in dollars and cents.

In appearance, "slab bands" are wide, shallow beams that span between or cantilever from the columns. Widths of bands may be as much as three or more times the depths, and the beams need not be centered on nor extend in a straight line between columns (Fig. 1). In design, the floor is treated as a continuous unit, with the band considered as the haunch of the slab.

The conception of a structure as composed of independent slabs, beams and columns is utterly fictitious. They are all members of one body. In a human body a load picked up by one hand will tighten the proper muscles in the arm, pull at the shoulder, bend the torso, increase the load on one foot and reduce it on the other. In a similar manner a load anywhere on a concrete structure is resisted through the continuity of the structure.

When steel beams are used, the separation of a floor into beams and slabs for design purposes appears logical. These beams, with their individualistic shape and different composition, seem to stand out as separate entities. Years ago, when concrete beams were introduced, many of the concepts pertaining to steel-beam construction were maintained, probably through mental inertia.

Concrete distribution important

Of necessity, the slab-and-beam idea was abandoned in the case of flat-slab construction. It would seem that, as a natural consequence, a revaluation of the proper distribution of concrete in the outmoded slab- and narrow-beam construction should also be made.

By determining just what the economical distribution of concrete is, instead of treating slabs and beams as separate entities, great advantages can be gained in many instances. It certainly would be strange if it could be demonstrated that the current practice of separating a floor into slabs and narrow beams is the right answer. As could be expected, it is not correct. On the other hand, it can be shown that slab-band construction utilizes a highly efficient distribution.

There are many factors involved in an analysis of proper concrete distribution; for example, relative construction costs of the various materials, standard sizes of plywood and lumber, methods of form construction, and the rigidity of framing members. Thus, the decision to use slab bands instead of slabs and narrow beams may be justified on many counts. While space limitations preclude retracing here the various steps that have led to the adoption of this type of floor in many cases, a comparative study based on a low-cost housing unit (live load 40 psf.), will

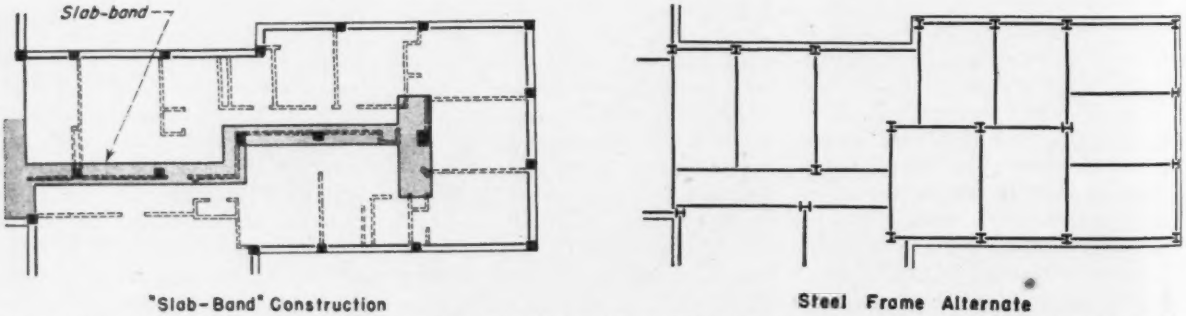


Fig. 1. A comparison of concrete "slab-bands," which are wide, shallow beams, with a steel frame designed to carry the same residential loads indicates the flexibility and simplicity of the former. "Slab bands" may be provided with elbows to turn corners or with cantilevers to extend their reach.

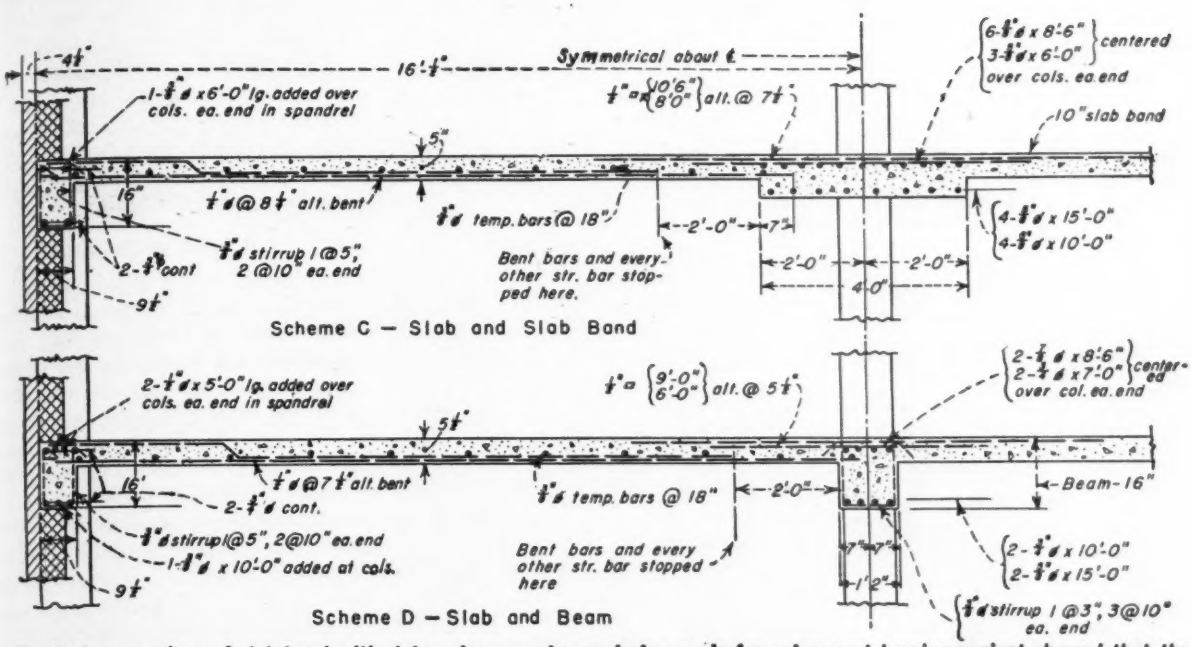

Symmetrical about ℄
16'-4"
4"
1-⅞" ø x 6'-0" lg. added over cols. ea. end in spandrel
t" = {10'6" / 8'0"} alt. @ 7t'
6-⅞" ø x 8'-6" / 3-⅞" ø x 6'-0" } centered over cols. ea. end
10" slab band
5"
16"
t" ø @ 8t' alt. bent
t" ø temp. bars @ 18"
2'-0"
7½"
4-⅞" ø x 15'-0"
4-⅞" ø x 10'-0"
⅝" ø stirrup 1 @ 5", 2 @ 10" ea. end
2-⅞" cont
Bent bars and every other str. bar stopped here.
2'-0"
2'-0"
4'-0"
9t"
Scheme C — Slab and Slab Band
2-⅞" ø x 5'-0" lg. added over cols. ea. end in spandrel
t" = {9'-0" / 6'-0"} alt. @ 5t'
2-⅞" ø x 8'-6" / 2-⅞" ø x 7'-0" } centered over col. ea. end
5t"
16"
t" ø @ 7t' alt. bent
t" ø temp. bars @ 18"
2'-0"
Beam-16"
2-⅞" ø cont.
⅝" ø stirrup 1 @ 5", 2 @ 10" ea. end
1-⅞" ø x 10'-0" added at cols.
Bent bars and every other str. bar stopped here
7"
7"
1'-2"
2-⅞" ø x 10'-0"
2-⅞" ø x 15'-0"
9t"
⅝" ø stirrup 1 @ 3", 3 @ 10" ea. end
Scheme D — Slab and Beam

Fig. 2. A comparison of slab-band with slab and narrow-beam design made for a low-cost housing project showed that the former required cheaper formwork and less concrete and steel.

be used as one example that demonstrates the superiority of slab bands (Fig. 2).

Results of comparative study

In general, the selected distribution of the concrete is a result of the following factors:

1. The slab-band is considered as a haunch of the slab, giving greater stiffness of the slab at the haunched end. Thereby, the initial fixed-end moments in moment distribution analysis and the carry-over factors tend to "draw" the negative moments toward the slab-band.

2. The *critical* negative moments are at the edge of the slab band, and although the maximum negative moment (at the center of the column) is increased, as compared with the narrow-beam design, the moment that determines the negative reinforcement in the haunched slab is smaller (Fig. 3).

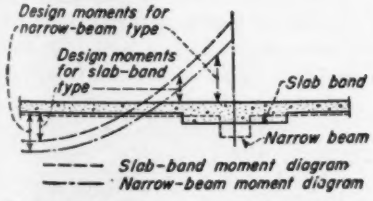


Fig. 3. Bending moments used in the design of the slab for slab-band construction are less than the corresponding slab moments for narrow beams.

3. As a consequence of the more efficient distribution of concrete in the slab-band design, less is required. Also, the total reinforcement in the slab is smaller, and this decrease in steel is so material that it far outweighs the excess steel in the slab band over that required in the beam, due to the relative depths. Quantities of materials for the two designs are compared in the accompanying table. Since prices fluctuate with time and location, no attempt has been made to arrive at a cost comparison. With all the material units given, it is an easy matter to make a comparison that will be in accordance with local conditions.

4. The wide soffit of the slab band is more economical to form, and the over-all cost of formwork is reduced.

5. In housing, it is quite usual to arrange the closets at the center of the wings, and thus, where the slab band occurs. The saving due to decreased height of closet partitions then becomes a considerable item.

6. Although the point that follows should be checked with local building codes, it seems obvious that a slab band needs no more fire protection than a slab, except at the edges. It is the spalling of the corners that has dictated the greater fire protection of narrow beams and columns. Requirements for fireproof buildings are based on fire ratings, and these are the same for both slabs and beams. In fact, the slab bands, except at the edges, are in no different category in their function than a column band in a flat-slab design. Only slab fire protection of reinforcement is required in such column bands.

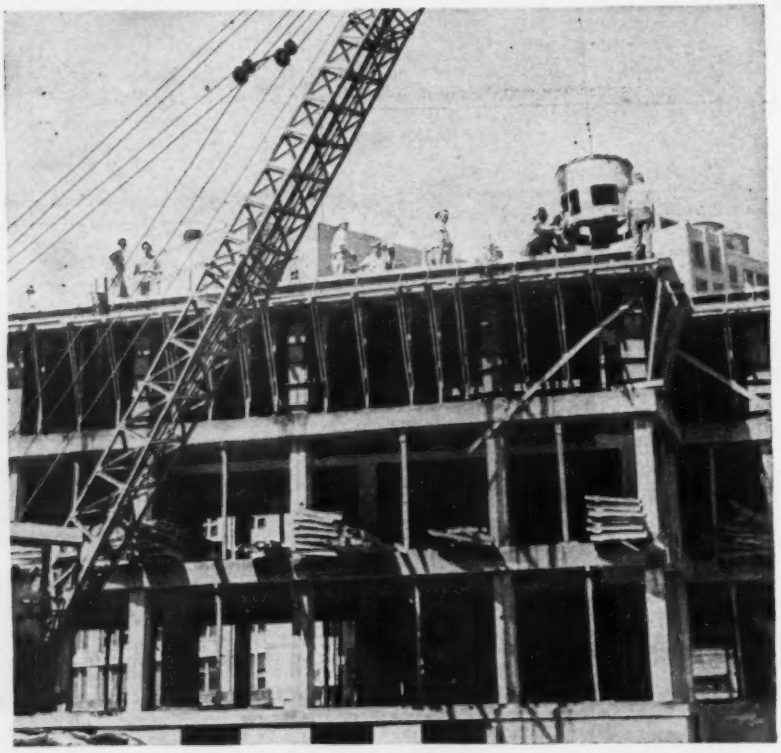
Other slab-band benefits

In addition to the advantages of slab bands already mentioned, there are other factors to consider: The columns need not be in a center-line straight-jacket but can be placed anywhere within the confines of the band to suit the partition layout. Since concrete columns have an inherent capacity for resisting bending, the

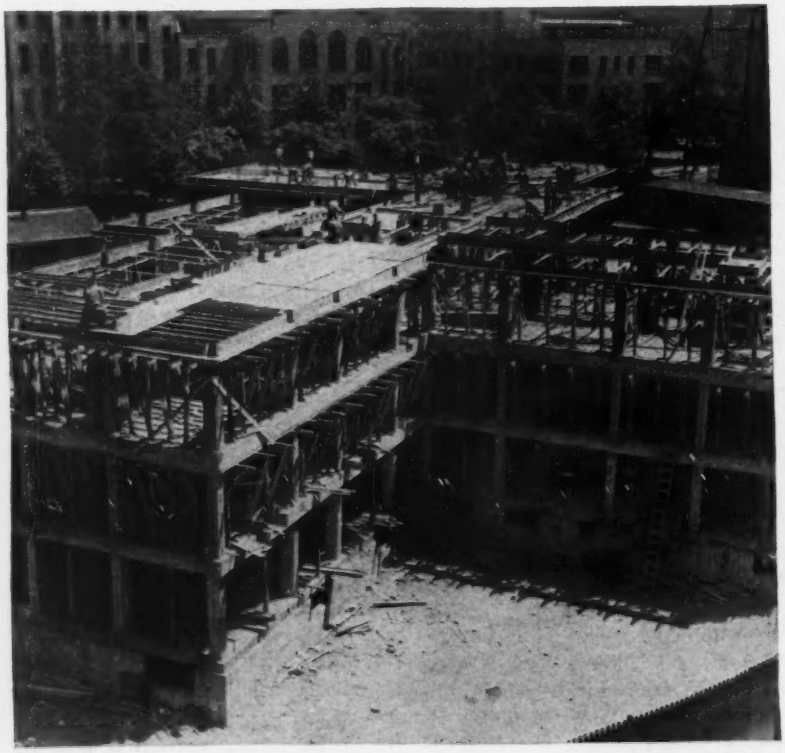
QUANTITY COMPARISONS

Item	Scheme C	Scheme D
Forms		
Beam or Slab-Band Sides.....	5.33 sq. ft.	6.17 sq. ft.
Soffits..... ...	5.58 sq. ft. (Wide Type)	2.75 sq. ft. (Narrow Type)
Slab.....	26.50 sq. ft.	29.33 sq. ft.
Concrete.....	0.61 cu. yd.	0.63 cu. yd.
Reinforcing Steel..	71.48 lb.	75 26 lb.

NOTE—Quantities are based on 1-ft. wide by 32-ft. 1-in. long strip. Column spacing is 15 ft. o. c. for reinforcement shown.



Slab-band floor construction is used in the multi-story Elliott Houses now being built in midtown Manhattan by the New York City Housing Authority. In the above view, the edge of a slab is visible spanning between interior column.



The slab band floors of the Elliott Houses are cast in plywood forms. At the extreme right are forms for a slab band T-shaped in plan.

eccentricity may usually be absorbed without increase in the size of the columns or in their reinforcement.

Two-way slab-band construction has also proved to be a handy method. Particularly when air-conditioning ducts were installed, this type has been instrumental in avoiding head-room difficulties.

Slab bands vs. flat slabs

In comparing a slab-band design with various types of flat slabs, it has been found that concrete and steel quantities are invariably less with a slab band. This is to be expected, since the stress flow between columns is greater than the stress flow from the center of the panels. The column bands in flat-slab construction are always much more heavily reinforced than the middle strips. A distribution of concrete to follow this stress flow is always efficient in so far as materials and dead weight are concerned.

Flat-slab formwork is cheaper, and a flat ceiling throughout has many advantages that must be carefully evaluated to gain an over-all picture. However, contractors familiar with the slab-band type have found that the unfavorable difference in formwork is not enough to offset other advantages. In fact, the saving in partition height alone with slab bands is often sufficient to counterbalance the additional form cost. In addition, the appearance of slab-band construction is attractive.

Value of intangibles

Too often, construction methods are selected solely on the basis of straight comparisons of typical panels. The answers are often taken as being complete, and sometimes other factors entering the situation are overlooked. These factors often can not be evaluated in dollars and cents, but they are there none the less.

Experience has shown that construction types tending towards greater beauty almost invariably have in them also factors of greater economy. Nature, being the most economical constructor, points the way in this direction. Engineers have a function not only to analyze methods in dollars and cents but to execute work with a greater measure of imagination and adherence to the principles of beauty.

Steel Building Code Changes Analyzed

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***Contents in Brief**—Several revisions were made early this year in the American Institute of Steel Construction specification for structural steel buildings. Arc welding standards were incorporated. Approval was given to the use of main compression members with slenderness ratios exceeding 120, if stresses are reduced by specified percentages. Also, beams with a ratio of unsupported length to width greater than 40 may now be used in accordance with a new formula for computing the stresses in compression flanges. Rivets and bolts in direct tension and butt welds are conceded the same unit stress as that permitted the connected parts, and continuous members are accorded a 20 percent increase in allowable stress at supports for vertical loads, but not for horizontal forces.*

WITHOUT having undergone extensive change for a decade, the American Institute of Steel Construction "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" was modified in February to incorporate welding standards and revisions in allowable working stresses. Recognition was given to main compression members with slenderness ratios above 120, to beams with span-to-width ratios over 40, to rivets and bolts in direct tension and to the theory of limit design for continuous beams.

Reflected in the specification, as revised this year, is a careful appraisal of developments in the field of experimental research and analysis and of improvements in fabricating technique, which have taken place in the past decade. The last extensive revision of this specification, which in its quarter century of existence has come to be accepted as the engineering standard covering the use of structural steel in building construction, occurred in 1936. At that time, the so-called basic stress was raised from 18,000 to 20,000 psi. to reflect the correspondingly higher minimum yield point specified for structural steel under American Society for Testing Materials Standards A 9 and A 7 (combined in 1939 as a single standard, A 7).

The first part of the ensuing decade was marked by considerable activity in the field of experimental research. Particular emphasis was placed on the importance of elastic stability as the criterion to which safety factors might properly be related, even outside the field of column design. Considerable study was also given to the behavior and useful limits of various types of connection details. However, at the very outset of the war, much of the experimental work was interrupted, although it was possible to continue some analytical work. Long before Pearl Harbor, the building industry was called upon to bend every effort toward providing new plant and facilities for the all-important war production program. When these were completed, it undertook a vital part in the production program itself.

Developments necessitate changes

Out of this intensive activity has come a rich experience, both for the fabricator and for the designing engineer; yet it probably is still too early to assess its full significance. Nevertheless, with the cessation of hostilities, the AISC Committee on Specifications found it desirable to reexamine its earlier recommendations in the light of several significant developments.

A first glance at the specification might give an erroneous impression that the recent revisions were quite extensive. This stems largely from the fact that, after a trial period, the major part of the separate AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings by Arc and Gas Welding," tentatively adopted in 1942, was incorporated in the earlier standard so as to provide a single inclusive specification. Other changes, dealing with allowable working stresses, may be regarded more in the light of refinements. They concern problems that occur infrequently and are likely to have limited application in actual practice. But the changes, in themselves, are significacant and the reasons for making them are of interest.

Extremely slender columns approved

A case in point is the new Section 16(b) which permits main compression members not ordinarily subject to shock or vibratory loading to have a slenderness ratio, l/r, in excess of 120. Here, l is the unbraced length of column and r the corresponding radius of gyration of the section. The unit stress under full design load is reduced by a formula, however, below the values permitted for slender secondary compression members.

A main compression member, as used in the specification, is one whose failure might be expected to cause an immediate collapse of the whole structure or a substantial portion. The earlier limitation of its slenderness ratio to a maximum of 120 represented a desire to insure, through ample bulk and stability, an especially high order of resistance in places where weakness would be particularly serious. The restriction admittedly was an arbitrary one. It was not intended to imply a smaller

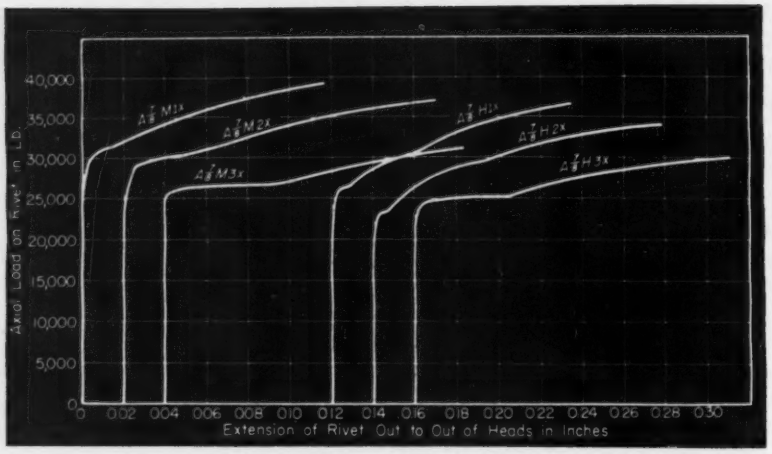


Fig. 1. Results of tension tests on ⅞-in. rivets show that no elongation occurs until initial internal stresses are counterbalanced by the external load.

factor of safety in the Rankine Gordon column formula,

$$f = \frac{18{,}000}{1 + l^2/18{,}000\,r^2}$$

which is applicable above 120, than in the parabolic formula,

$$f = 17{,}000 - 0.485\,l^2/r^2$$

which is applicable below 120.

Recently, the committee's attention was drawn to a type of main compression member, such as the columns supporting the light roof framing of a shed-type building having no enclosed sides. In these cases, the lightest columns that could be designed with a ratio of 120 or less would be subjected by the possible design loads to an absurdly low unit stress. It was obvious that such waste of material was unnecessary, and the situation was met by permitting the use of main members with ratios from 120 to 200, subject to a progressively increasing reduction of the allowable unit stresses given by the Rankine-Gordon formula.

The percentage of these stresses that can be used is given by $1.6 - l/200r$. Therefore, the reduction progresses from zero at a slenderness ratio of 120 to 40 percent at a ratio of 200. Because the permitted stresses above the 120 ratio are low, reasons of economy generally dictate that main compression members carrying substantial loads be designed with a relatively large radius of gyration so as to avoid the stress penalty. Thus, a more reasonable utilization of material in the cases indicated is permitted without abandonment of the position that main compression members should have ample safeguard because of the serious consequence of their failure.

Buckling stresses revised

Previous editions of the AISC specification, in common with many other specifications, recognized that a long beam without lateral support would fail by buckling sidewise at a unit stress less than that for similarly loaded beams having lateral support. This situation was met by a formula that progressively reduced the permissible unit stress in bending as the length-breadth ratio (l/b) increased from 15 to 40, ratios above 40 being prohibited.

Investigators have shown, however, that beams have a useful, predictable capacity above the l/b ratio of 40 ("Strength of Slender Beams," by Prof. George Winter, *Transactions*, American Society of Civil Engineers, 1944), and that the strength of a laterally unsupported beam depends upon factors other than unbraced length and breadth of flange. The buckling of a slender beam is resisted by those elements that contribute to its torsional strength. Thickness of flange is a factor as well as width. Of two beams with equal flanges, the shallower beam will be more stable because of the assistance given the top flange by the restraining effect of the tension in the bottom flange.

By an extension of the theory given by S. Timoshenko in his "Theory of Elastic Stability," Karl DeVries has derived a formula that takes all of these variables into account. ("Strength of Beams as Determined by Lateral Buckling", *Proceedings*, ASCE, Sept., 1946).

$$f = \frac{12{,}000{,}000}{ld/bt}$$

The committee felt that the evidence in the DeVries paper was adequate to justify the adoption of this formula and with it the removal of any arbitrary upper limit on length for the

RESULTS OF TESTS ON RIVETS IN PURE TENSION

Note: In the designation of the specimen, the fraction indicates the diameter of the rivet before driving. M indicates that the driving was by machine, and H that it was by pneumatic hammer. The figures 1, 2, 3 suggest the variation of grip, 1 being the smallest and 3 the largest.

Specimen	Nominal Grip of Rivet, In.	Total Maximum Load on Rivet, Lb.	Ultimate Unit Stress on Rivets in Lb. per Sq. In.		Average Ultimate Tensile Strength of Bar Stock from which Rivets were made, Lbs. per Sq. In.
			On Area Before Driving	On Area After Driving	
A ⅝ M1x	1	23,870	77,850	64,280	
A ⅝ M2x	1½	22,270	72,600	60,000[1]	
A ⅝ M3x	2	22,370	72,920	60,250	52,500
A ⅝ H1x	1	25,450	83,000	68,550	
A ⅝ H2x	1½	22,740	74,150	61,300	
A ⅝ H3x	2	20,200	65,850	54,420	
A ¾ M1x	1¼	37,790	85,500	72,850[2]	
A ¾ M2x	2	33,350	75,500	64,300	
A ¾ M3x	2½	30,230	68,450	58,300[3]	55,275
A ¾ H1x	1¼	34,620	78,400	66,750	
A ¾ H2x	2	31,380	71,000	60,450	
A ¾ H3x	2½	30,430	68,900	58,650	
A ⅞ M1x	1½	41,990	69,850	60,800	
A ⅞ M2x	2	39,930	66,450	57,850	
A ⅞ M3x	3	35,530	59,100	51,470	45,560
A ⅞ H1x	1½	40,345	67,150	58,440	
A ⅞ H2x	2	36,820	61,270	53,380	
A ⅞ H3x	3	33,140	55,160	48,000	

[1] Head sheared off. [2] Very eccentric head. [3] Very eccentric head.

function *ld/bt*. The full value, 20,000 psi. is permitted up to the point where *ld/bt* equals 600, when the formula takes over. This is somewhat analogous to the old prescription of 20,000 psi. up to a length-breadth ratio of 15.

A comparison of the working stresses permitted by the present *ld/bt* and the former *l/b* formulas, as applied to rolled beams, will show that the new formula, in general, increases the unsupported length for which a stress of 20,000 psi. is permitted. When the new formula is used for longer unsupported spans, the allowable stress for the heavier beams of any given depth is generally increased, while that for the lighter beams of the same depth is decreased.

It will be noted that the product *bt* expresses the area of the flange. In the case of a plate-girder flange composed of angles and cover plates riveted together, a value of ¾ of the combined area of the cover plates and the outstanding leg of the angles of the compression flange would be a proper substitute for *bt*, according to an analysis of the problem in Mr. DeVries' paper. When the moment of inertia of the compression flange about the minor axis of the beam is substantially greater than that of the tension flange, as in the case of a crane girder with a horizontal channel attached as a cover plate to the top flange, substitution of the full area of the channel and the top flange of the rolled beam for *bt* would give working stresses on the conservative side.

Direct tension allowed in rivets

Another change in the specification affecting stresses accords rivets and bolts in direct tension the same allowable unit stress as that permitted the connected parts. In approving this, the committee has taken a step believed long overdue by many engineers, but one which it had been reluctant to take while a widespread misconception of the effect of initial tension persisted. The fact that the initial internal tension and the tensile stresses resulting from externally applied loads are not additive, but rather that the true stress is approximately equal to the larger of these two, is now generally recognized.

Typical of the behavior of rivets in direct tension is the data given in the accompanying table prepared by

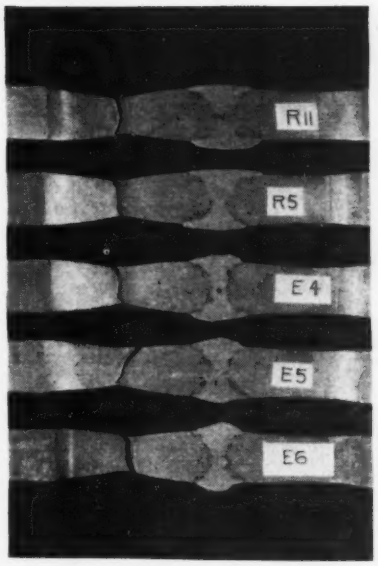


Fig. 2. Base metal failures in static tension tests of butt-welded steel specimens are an indication that the weld metal is at least as strong as the steel it joins, (University of Illinois Engineering Experiment Station Bulletin 344).

Prof. C. R. Young ("Tensile Working Stress for Rivets," AISC Annual Convention, 1927). The ultimate unit stresses tabulated were determined by dividing the total externally applied loads by the areas of the rivets. Rivet stock used in the manufacture of the ⅝- and ¾-in. diameter rivets conformed to the requirements of ASTM standard for structural rivet steel, A141-39, as to physical characteristics; the ultimate strength of the bars from which the ¾-in. diameter rivets were made was slightly deficient. The ultimate strengths of the driven rivets, as determined by the load tests, agree closely with the requirements of A7 structural steel.

That the initial tension due to shrinkage has little bearing on the tensile capacity of the rivets for externally applied loads is quite apparent from a comparison of the stresses resulting from the applied loading with the recorded ultimate strength of the rivet stock before driving. Also of interest, as illustrating the theory for the behavior of the rivets with respect to initial tension, are the stress-strain curves shown in Fig. 1 for a number of the tests listed in the table.

It will be noted that no elongation was observed in the rivets until the external load had reached substantial proportions. During this interval the increasing external load was merely "picking up" the internal forces already in the steel parts, which had been clamped together by the shrinkage of the rivet. After this operation had been completed, additional external loading produced the elongations in the rivets that appear in the stress-strain curves.

This interaction of internal tension and tension resulting from externally applied loads, accounted for on the basis of the elastic behavior of all of the parts involved, is, of course, equally applicable whether the initial tension is produced by shrinkage in a cooling rivet or by the tightening of the nut on a bolt. Since 1939, ASTM Specification A7 has provided that bolts to be employed in permanent connections between parts fabricated of A7 steel shall have a minimum tensile strength, taken on the area at the root of the thread, not less than that of the steel in the connected parts. Hence, having taken the precaution of requiring the addition of an impact factor to design live loads that could, through vibration, create the condition associated with "fatigue loading" (reversal or substantially complete release of load, many thousands of time) the committee recommended a unit working stress in tension equal to that permitted in the connected parts.

Tension in butt welds

An increase in stress to that allowed the connected parts has also been accorded butt welds in tension. ASTM specification for arc-welding electrode, A 233-43T, prescribes minimum values for the physical characteristics of filler metal deposited by any of the E60 series of electrodes, as evidenced by specified all-weld-metal tension tests. These properties are comparable with corresponding characteristics of A7 structural steel. Static tests of butt welds made with these materials, which are those provided for in the AISC specification, have consistently yielded unit tensile stresses at least equal to the ultimate strength of the base metal. Final rupture has consistently occurred in the base metal, outside of the welds.

In Fig. 2 is shown typical static tension test failures of butt-welded

specimens employing E60 electrodes and ⅞-in. carbon steel plates meeting the physical requirements for A7 steel. R11 and R5 were welded in the flat position; E4, E5 and E6 were welded in the vertical position. All welds were made by qualified operators, but under ordinary commercial conditions. While the specimens shown were tested in the as-welded condition (the normal convex surface of the welds was not planed down flush with the plates), elimination of the convexity has had no effect on the consistency with which the ruptures occur away from the welded zone.

Continuous-beam stresses raised

Substitution of the higher allowable unit stresses set up in the War Production Board's emergency specification for those contained in the AISC specification prior to the war was given careful consideration. In the absence of the circumstances that had seemed to make these higher stresses desirable during the war, the committee did not feel justified in recommending their general adoption for peacetime use.

At the same time, it was recognized that certain refinements in stress analysis, which have now become common practice, are somewhat penalized if the design of continuous and semi-continuous frames must be based upon flexural working stresses originally established for use in connection with the older, more approximate design methods. Nevertheless, it was felt that more study was needed before any broad distinction could be drawn between the working stresses to be used in connection with precise stress analyses and with empirical ones. For the present at least, and possibly for some time to come, it was believed, the preponderance of computation is likely to be based on approximate design assumptions.

An increase in bending stress, not to exceed 20 percent—in other words, not larger than the 24,000-psi. bending stress permitted under the emergency specification—was approved for use in proportioning certain parts of continuous members. The conditions under which this increase is sanctioned do not encompass the full range of application of precise stress analysis. For one thing, the provision does not apply to stresses resulting from horizontal loads, since continuity at the supports is directly responsible for the stability of a structure under such loads. Justification for the increase, therefore, may be said to rest more upon limit design ("Theory of Limit Design," by Prof. J. A. Van den Broek, *Transactions*, ASCE, 1940) than upon a general recognition of refinements in stress analysis.

Simple beams v. continuous

This may be seen from a comparison of two adjacent simple spans of equal length, uniformly loaded, and a beam similarly loaded but continuous over both spans. The generally accepted critical design moment is the same, $Wl/8$. Nevertheless, the ultimate load capacity of the two types of framing are far from equal. A load that will cause a complete collapse of the simple-span beams due to the magnitude of positive-moment stresses will not cause failure of the continuous beam. It merely marks the limit beyond which the stresses due to the negative moment at the intermediate support cease to afford material assistance in resisting any greater applied moment.

The action that occurs in the continuous beam at these or larger loads are a result of the ductility of the

Fig. 3. Built-up building columns using perforated cover plates instead of lacing bars, as in the Mississippi River Bridge at Baton Rouge, La., shown above, are made more economical by a revision in the AISC specification.

metal. Because of the ductile characteristics peculiar to steel of grades similar to A7, strains many times greater than those representing the entire elastic range occur at or slightly above the yield point with little, or no, additional loading, and with no damage to the material other than a permanent deformation. It is this phenomenon which makes possible the bending or cold-working of parts during fabrication, without impairment of their usefulness when they are later incorporated in the structure.

To visualize the problem in its simplest form, let it be assumed that no additional load can be placed on a simple-span beam, nor on a fully fixed-end beam of equal span, without complete collapse after the extreme fibers resisting the positive bending moment have reached a yield point stress of 33,000 psi. In addition, assume that no further assistance is afforded these same fibers on the fixed-end span after the extreme fibers at the restrained ends have reached a yield point stress of 33,000 psi. Both of these assumptions err on the conservative side, as experimental work reported by Prof. J. E. Baker in the *Transactions* of the Institute of Welding (British) has clearly shown. But they will furnish a basis for approximating the relative usefulness of the two types of beams when each of them is loaded nearly to destruction.

In the design of continuous beams such as are shown here, stresses at the support due to vertical loads may be 20 percent higher than for simple beams.

Fixed-end beam takes larger load

Since conventional design procedure requires that the simple span be proportioned for a bending moment of $Wl/8$ and the fixed-end span for $Wl/12$, section modulii in the ratio of 3:2 will be selected for the two spans. Hence, in both cases the same load will produce the permitted 20,000-psi. working stress—in the first case at mid-span, in the second at the restrained ends. Loads will then be added to each span until the center-span extreme fiber stresses in each reach 33,000 psi.

Up to the point where the extreme fiber stresses at the restrained ends of the fixed-end beam reach 33,000 psi., the moment produced by its increased loading will be distributed $\frac{2}{3}$ to the restrained ends and $\frac{1}{3}$ to mid-span. At this stage in the loading then, the mid-span extreme fiber stress is one half of 33,000 psi., yet the total applied load is equal to the "failure" load for the simple span.

Beyond this point, it will be assumed that the portion of the beam over the support merely deforms without carrying additional load, due to the ductile nature of the steel at greater than yield point stress, and that the mid-span section must carry the added loading. Even on the basis of these assumptions, it is evident that the "failure" load for the fixed-end beam would be at least half again that for the simple-span beam. Investigation has indicated that actually it is considerably higher.

Based on this consideration, the 20 percent increase permitted in the flexural working stress for continous beams at points of interior support will be recognized as only a modest step in the direction of balancing the real capacities as between continuous and simple-span designs.

Similar "limit-load" considerations, also corroborated by experimental work such as that reported by Professor Baker, were the basis for the recommended increase in the allowable bending stress to be used in proportioning columns subjected to bending moment by partially or fully restrained beams under gravity loading. Here, however, two other considerations might be advanced in further support of the recommendation.

In the first place, entirely satisfactory results have been consistently realized even when such bending stresses have been completely ignored, as has probably been the rule rather than the exception in most tier-building designs of ordinary size structures. In the second place, the probability of any live-load distribution inducing single curvature in the columns with attendant high bending stress through continuous-frame behavior is almost non-existent. Hence, with the allowable direct stress reduced, as provided by the column formulas, to compensate for possible stresses induced at mid-story height by accidental eccentricities, a needless penalty is imposed on the design if the direct stress is combined with the full bending stress, which is at floor levels rather than at midstory, and the ratio $f_a/F_a + f_b/F_b$ is held to unity, with F_b equal to 20,000 psi. maximum instead of the 24,000 maximum as now provided.

Perforated cover-plate design

Another interesting revision in the specification is the new provision (Section 29d), which permits the substitution of cover plates perforated with access holes according to certain fixed proportions for lacing bars in built-up members. This is the outgrowth of a research program conducted at the National Bureau of Standards and reported in the *Journal of Research*, vol. 28, 1942, and vol. 30, 1943. The net area of such perforated cover plates may be included with the area of the connected components in proportioning the member to resist axial stress.

New Ideas for Building Advanced To Hasten End of Housing Crisis

***Contents in Brief**—As a direct outgrowth of the guaranteed markets provisions of the Veterans Emergency Housing Act, an ever-increasing number of new and substitute materials and construction methods is being developed by private industry. Among the most promising prospects being studied by the National Housing Agency are structural concretes weighing about 50 lb. per cu. ft. or less, thin metal sheets bonded to a core of non-scarce material, wall and floor panels made of waste products, as well as miscellaneous equipment, such as special windows, knock-down door jambs, and combination wall bases and conduits.*

SIGNIFICANT economies in building construction, and possibly some useful changes in building design, may develop as the result of studies of new materials and construction methods now being made by the National Housing Agency. Some of these materials, such as light-weight concretes, are simply improvements over fairly well known and accepted products; others, like the metal-faced wall panels with cores of structural and insulating materials, must win acceptance by designers and building code authorities before their potentialities can have any effect on building trends.

In the past, new and untried building materials have had an uphill fight to win sufficiently wide acceptance to permit their production in large quantities. Today that situation is completely changed by a provision of the Veterans Emergency Housing Act that guarantees to producers of new types of materials a market sufficient for economical production. To qualify for a market guarantee or for priority assistance, a material must be found to be acceptable by the NHA Technical Office.

This guarantee of a market for products that meet with the approval of the NHA Technical Office lends special significance to the studies of building materials now being made under the supervision of that office, the more important of which are reported in the following. Such guarantees should advance by many months, if not years, the widespread adoption of radically new building materials, especially as one branch of the NHA Technical Office is devoting its attention to the important matter of facilitating the revision of building codes to permit the use of approved materials.

Wilson W. Wyatt, Housing Expediter of the NHA, was given these wide powers in the expectation that stimulation of the economical production of new building materials would facilitate the construction of housing for veterans and might also keep down the cost of such housing. It appears probable also that the NHA studies and financial support for commercial production may, in the end, have an important bearing not only on housing, but on other types of building as well, due to the possibilities for reducing dead loads through the use of the materials that are under consideration. Thus, mass production and prefabrication techniques in building applications will be advanced.

Function of the technical office

The NHA Technical Office has four major divisions. Its Planning Branch is responsible for the solution of architectural problems connected with mass production of low-cost housing and for the development, review and appraisal of systems of construction from the viewpoints of planning, efficiency, cost, livability, and health and safety standards. The Engineering Branch is similarly charged with the solution of technical problems connected with the large-scale production of low-cost housing and with the study and review of systems of construction from the viewpoints of structural requirements, assembly, shipment and on-site construction. The Building Regulations and Construction Standards Branch is assigned the task of developing model building codes, performance standards and testing procedures to facilitate the housing program. And the Materials and Equipment Development Branch deals with new and substitute materials, building components, equipment and related production methods.

The Technical Office is now analyzing numerous new materials and systems of construction. Samples of the former have been turned over to the Forests Products Laboratory, the National Bureau of Standards, the Agricultural Research Station and other government and institutional testing organizations. Tests are made not only on individual items, but on entire houses utilizing the new materials or older products in new applications.

In addition, the Technical Office is reviewing new structural methods that reduce the need for scarce articles. What the NHA is aiming at is the intensive application of the mass-production, assembly-line techniques of the automobile industry to the field of housing.

The new building products being reviewed are, in general, made either from non-scarce raw materials or a combination of these with those in short supply so as to use a minimum of the scarce items. After a preliminary study, NHA has found a substantial number to be practical for utilization in the emergency housing program. Some of the materials that appear to have a promising future in the building industry are described in the following.

The development of structural concretes weighing in the neighborhood of 50 lb. per cu. ft., as contrasted

with the usual contemporary conception of lightweight concrete as weighing about 90 or 100 lb. per cu. ft., will undoubtedly stimulate the demand for precast units of these materials. Two major types have come to the fore, one using lightweight inorganic aggregates and a second using farm and forest wastes. In addition, new possibilities are visualized for a third type—foamed concrete—in which an admixture is used to expand the mix.

One of the important lightweight aggregates is perlite, a vesicular volcanic rock found mostly in the western part of the United States. When heated to 1,800 deg. F., perlite expands to a density of 10 to 15 lb. per cu. ft., and in some cases it is as light as 3½ lb. per cu. ft. It makes a concrete weighing from 45 to 55 lb. per cu. ft. with an ultimate compressive strength of 1,100 psi.

Large-scale use of volcanic rocks of this type as aggregates has not been uncommon on the west coast. For example, pumice has been used to produce a concrete of about 70 to 80 lb. per cu. ft., with a compressive strength in the neighborhood of 800 psi. A test program to correlate data on lightweight aggregates is planned by NHA and will be executed jointly by the Bureau of Reclamation and the National Bureau of Standards.

Lightweight, fire-resistant, structural concretes that can be nailed and sawed are being made of wood and vegetable fibers. Weighing less than 50 lb. per cu. ft., these concretes contain organic fibers in quantities varying from about 75 to 90 percent of the total bulk. A mix of straw and wood fiber with portland cement, weighing from 30 to 50 lb. per cu. ft., shows a compressive strength varying from 500 psi. for the lighter concretes to 2,300 psi. for the heavier, with corresponding tensile strengths of 175 to 500 psi. Wood fiber, emulsified asphalt and portland cement yield a material with a density of 50 lb. per cu. ft. and a compressive strength of 1,500 psi. With addition of a chemical to assist the adhesion of cement and wood, a concrete composed of wood fiber, asbestos and cement, weighing 50 lb. per cu. ft., withstands a stress up to about 2,070 psi. in compression and 410 psi. in tension. Still another combination—wood fiber, synthetic resin and portland cement—with a weight of only 42 lb. per cu. ft. can sustain up to 1,800 psi. in compression. These fiber concretes are looked upon as a building material of much promise.

Waste wood utilized

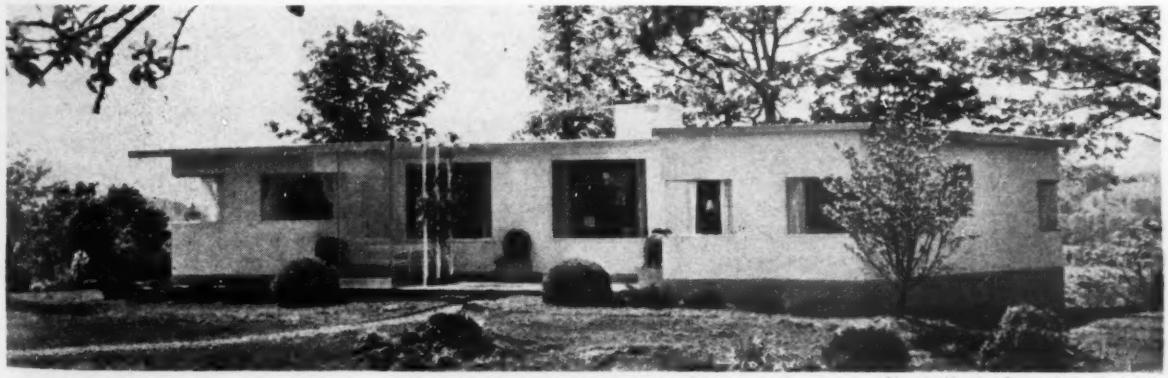
Another method of using wood and vegetable fibers to replace building materials in short supply is to manufacture wallboard of these waste products. In one case being studied by the Technical Office, straw is fiberized and made into ½ to ¾-in. thick board by felting. It is believed that four plies with ⅛-in. opposite facings of compressed strawboard would be suitable for use as an exterior wall panel. Other boards under study utilize waste wood bonded with synthetic resins or corn cobs bonded with phenol resin.

Developed by the Tennessee Valley Authority, a flooring consisting of 3 plies of veneer from non-commercial logs is under study as a possibility in relieving the shortage of hardwood lumber. The ¼-in. plies, bonded with a resinous plastic, are assembled in 12-in. wide sections up to 20 ft. long. They are provided with a wearing surface of select hardwood, and their under-surface is treated to prevent absorption of water. While this board is priced higher than ordinary hardwood flooring, some of this cost may be saved in construction if, as is claimed, it is easier to lay.

Other substitute flooring materials that are being considered consist of a patented fire-resistant mixture of macerated wood fibers and cementitious substances. The method of application consists of mixing the ingredients with water, trowelling into place, curing for at least five days and finishing by sanding, waxing, shellacking or varnishing.

Used over any kind of subfloor, the mixture produces 28 sq. ft. of ½-in. thick floor per bag at a cost of roughly 30c. per sq. ft. It has a specific gravity of 1.21, compressive strength near 4,000 psi., tensile strength about 500 psi., modulus of rupture of 533 psi., modulus of elasticity in the vicinity of 700,000 psi. and water absorption of about 6 percent in 24 hr.

Wall and roof materials being surveyed fall into two general classes, according to composition: treated plywood and structural panels made from substitutes for lumber and plywood. Reinforcing the currently scarce plywood with plastic or with sheet metal reduces the amount required for a given strength. In addition the strength and rigidity of the facing is increased. A panel consisting of 2 sheets of ¼-in. plywood each faced on the exterior with sheet steel about 0.01 in. thick has a coefficient of heat transfer with a rock wool core of



Lincoln Houses Corp., New York City

Made of aluminum-faced panels with a core of heavy paper expanded into ¼-in. square cells and impregnated with a phenolic resin, houses of this type can be built at a substantially lower cost than that of conventional dwellings, according to the manufacturers. The panels weigh about one pound per square foot.

0.247 B.t.u. per sq. ft. per deg. F. per hr. for a 2-in. thickness; for a 3-in. panel the coefficient is only 0.16. When reinforced with internal spacers, the panel is said to have ample strength for use in floors as well as in walls and roofs.

In the second of the two classes of wall and roof materials are various types of concrete panels. One interesting assembly now under test consists of two 1-in. thick, wire-mesh reinforced concrete sheets held about 2 in. apart by perforated metal channels. Another is a rectangular frame about 6 or 7 in. wide by 54 in. long with 2-in. ribs 16 in. apart. One story high, the panel has 3-in. thick edges, a 1-in. interior face and a 2-in. exterior. Still another intriguing construction is a panel composed of a 2½-in. thick, 1:4 cement and vermiculite mix, made with about 20 gal. of water per sack, sandwiched between a ½-in. plaster interior facing and a 2½-in. vacuum-processed, dense, 1:5 concrete exterior slab, made with about 6 gal. of water per sack of cement.

Some concrete panels are used with metal facing. One that has been tested consists of 54-lb. per cu. ft. of foamed concrete (expanded about 40 percent), faced on both sides with 18-ga. porcelain-enameled steel. A 4 x 8-ft. unit, 2½-in. thick, has a coefficient of heat transfer of 0.231, and a 2⅝-in. panel can sustain 1,600 lb. per linear foot in compression.

Other types of core may be used with enameled steel facings, which are washable and may be obtained in various colors that will not fade. For example, an experimental house now under construction in the Chicago area has a light-steel frame covered with 4 x 8-ft. vitreous enamel panels about $\frac{1}{16}$-in. thick and insulated with rock wool. Except for screws, there are no metal-to-metal connections. Having packaged porcelain-enamel kitchen and bathroom units with a plastic floor, a 2-bedroom house of this type with an area of 1,051 sq. ft. is expected to sell at about $6,600 exclusive of land.

Considerable enthusiasm is being expressed over the possibilities of light-weight structural plastic cores. For fireproof construction, asbestos-cement facings may be used. Experimental houses have been built using 0.02-in. thick aluminum sheets as facings, with an inserted vapor barrier and a cellular core of kraft paper impregnated with thermo-setting phenolic resin. Panels weigh about 1 lb. per sq. ft. Tests indicate that the material will not support combustion.

Used for either load-bearing or curtain walls and for roofs, in which case the compression face is thickened slightly, a 3-in. thick assembly has a coefficient of heat transfer of about 0.21. There is only about 0.033 sq. ft. of contact between core and aluminum per square foot of wall. Subjected to wind load, an 8-ft. panel sustained 60 psf. within the proportional limit, 130 at failure. The panel can suport a vertical load of 5,100 lb. per ft. It is indicative of the panel's high strength that a 12-ft. roof span under test carried 66 psf. within the proportional limit and 96 when permanent set occurred. In eccentric tension tests, the aluminum failed, not the core. An experimental 4-bedroom house of this type sold for $6,000 exclusive of land.

Installed equipment affected

The use of shop-made panels in some instances precludes the use of conventional installed equipment and in other cases requires parallel development of equipment for rapid installation. Hence, to expedite applications of the newer constructions, NHA has had to stimulate the development of new equipment for use with them. A case in point is windows, for which special framing is required.

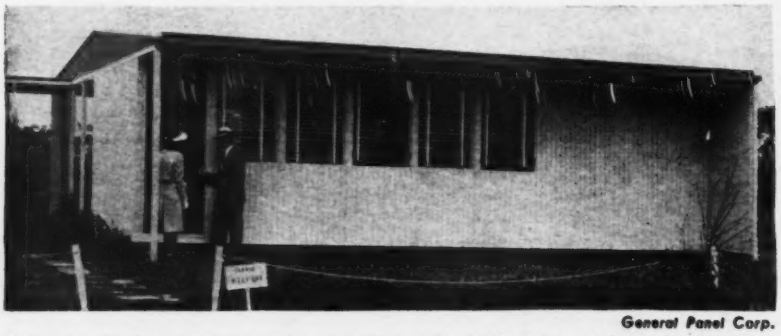
One type of window under study has an aluminum frame and sash, no mullions. Double hung, it has metal-band springs in the jambs to permit removal of the sash and to provide friction to hold the sash in position without the aid of balances. A 3x4½-ft. window sells for about $12.50, and a 16x20-in. size for $8.

Because of the difficulty in providing electrical wiring in the prefabricated panels, further development of a combined wall base and conduit is being encouraged. One type under study is a 2-piece wall base of 18-ga. steel, 3½ or 5½ in. high and about 1 in. wide, one piece being fixed to the floor, the other being detachable.

Another item under consideration is a 3-piece knock-down steel door frame that sells for about $4 f.o.b. Weighing about 28 lb., it is shipped in a 1-cu.ft. package. Of 18-ga. metal, about 5 in. wide, and easily assembled on the site, it will tie into wood-stud, steel-stud, tile or masonry walls.

An interesting soil-pipe connection is also being studied as a means of expediting construction. Said to require only one-third the time of ordinary installations, this cast-iron pipe connection is made by shooting a sealing compound through a pressure fitting in a special closed-mouth bell with a calking gun. The compound, capable of withstanding pressures of from 500 to 1,000 psi., is claimed not to deteriorate as rapidly as materials usually used for soil-pipe connections. Savings obtained by this process may be seen from estimates of cost based on a 5-ft. length of pipe and connection. For lead-calked pipe, the cost is about $7.72, of which $2.50 is for installation; and for the new pipe, the cost is about $6.82, of which only $1.25 is for installation.

For the National Housing Agency William V. Reed is director of the Technical Office; C. Theodore Larson, assistant director; Leonard G. Haeger, head of the Engineering Branch and acting head of the Planning Branch; C. A. Willson, head of the Building Regulations and Construction Standards Branch; and R. Harold Denton, head of the Materials and Equipment Development Branch.



General Panel Corp.

Mass production of insulated plywood panels, 3 ft. 4 in. x 10 ft., is expected be under way soon in California. A 2-bedroom house may sell for $4,500.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Adobe Houses

Sir: I know I am simply repeating what has been said maybe a thousand times by others, though to little or no avail, when I say the cheapest and most efficient building material available is right under our feet. I refer to both tamped, or "rammed earth", as it is popularly called and adobe bricks. I have built in my life 4 adobe brick houses, and I know no other houses I lived in ever were as cheap, as practical, as resistant to temperature change, as warm in winter, as cool in summer, nor as economical of fuel as were these 'dobe brick houses.

With temperatures such as occur in the windswept high elevation valleys of Colorado, the Dakotas, Utah, Wyoming, and Aizona, many persons, including myself, have found that they are the most satisfactory house which can be built in climates whose temperatures run from 130 deg. above, to 45 deg. below zero. My last 'dobe was constructed in Colorado, where it cost me $22.00 per 1,000 bricks, 15x8x4 in., laid in place. If the houses are built on a concrete foundation, so that ground seepage or moisture cannot reach the dobies, say 6 to 12 in. above the ground level, they will stand for a century or more.

These dobe houses can be built for 30 to 50 percent less than any other type of house being built today.

M. PHILIP SHERIDAN
Florence, Colo.

Housing Still Unsolved

Sir: Evidence increases that the housing industry is not geared to take care of housing as it should. Here in St. Paul, for example, marriage licenses have fallen far behind building permits and this, in fact, is a chronic condition of some years' standing.

One of the principal problems continues to center on housing for the low-income groups.

In 1935 the U. S. Department of Commerce in its financial survey of urban housing covering sixty-one cities found that in ten cities in the Northwest Central States 86% of the population had an income under $2,000. Also the Department of Labor Statistics show that something over 5,000 house builders build one house a year in the $5,000-$6,000 class and something under 4,000 house builders build one house each a year in the $6,000-$7,500 class. I recall a house building contractor here in St. Paul telling me in 1940 that he would not undertake to build a house for a person who had an income of less than 4,000 per year.

It is apparent and has been for a long time that the house building industry cannot take care of the housing situation. It is also apparent that government housing has done a very poor job—they put better material in their houses than any private person would think of doing. The Sumnerfield federal housing project of Minneapolis, for instance, cost $2,000 per room.

As you say in your editorial "New Housing Horizon" (*ENR* Sept. 5, 1946 vol. p. 291) for any insurance company to enter this field is the most promising situation that has developed.

GEORGE H. HERROLD
Planning Engineer
City Planning Board of St. Paul, Minn.

Training for Management

Sir: There is a general opinion amongst construction contractors, engineers and others that the present shortage of trained men for supervision and management of extensive construction projects will become more acute. The rate at which our construction operations are expanding far exceeds the rate at which we are training men to take responsible jobs.

Regardless of the magnitude of the projects within our own borders, we are undertaking work abroad to an extent never considered prior to 1940. Some of our largest firms and their best men are taking up foreign projects that will require several years to complete. This is only one of many reasons for the home shortages.

A recent report of the American Society for Engineering Education points out that in civil engineering alone we will need about 20,000 more graduates per year than our universities can produce on their prewar schedules. It estimates that seven years will be required to overcome this shortage. If that is the case in civil engineering, how much more will we short of superintendents and managers?—Probably ten times as many. will be required.

Certain associations within the construction industry have taken initial steps towards a remedy. They have appointed officials or committees within their own organization to study what can be done to solve the problem. Such action has already been taken by the Associated General Contractors, American Road Builders Association, and others. However, so far this is rather a recognition of the problem than any effective solution.

One college, to the writer's knowledge, has set up a plan for a two years short course in construction management (limited to 8 subjects). This will not be a course leading to a degree. It is intended to give only the most essential educational subjects that a student should acquire to take over responsibilities in a supervision capacity. A diploma or certificate will be granted only to those who have fully qualified. This will be a guide to an employer in forming an opinion as to the quality of the man he is taking on.

If we had a hundred universities and colleges offering such a short course, we would still be a long way from meeting the demand.

The construction industry has a responsibility to assume as well as a benefit to derive in supporting such a set-up in suitable educational institutions. It is quite an undertaking for a college faculty to amend its curriculum and add to its staff; but it can thereby supply a very practically trained graduate who can step into a construction job equipped with essential knowledge of what he is expected to perform. The colleges can incur this responsibility only if the industry will do its part, not only by

vocal and financial co-operation, but by taking a continuing interest and obligation to work with the colleges to see that the efforts are made in the practical direction desired.

NORMAN DE WIND
Annapolis, Md.

Construction Cost Estimates

Sir: A large proportion of current construction operations is being let on some form of agency contract. On the work so let, construction firms assume no financial risk as to ultimate cost. This makes it imperative that the buyers of construction service should clearly understand that in times of rising cost, estimates based solely on current costs are inadequate. Accordingly, it is advisable for the buyer to satisfy himself that the estimate presented includes adequate allowance for continuing rise in costs. Unlike the pricing of an existing commodity, a proper construction estimate is an attempt to forecast future costs.

In a rising market, an estimator uses current costs as a base. To this, he should add allowances sufficient, in his best judgment, to cover the increase in costs that may develop during the life of the job.

Beyond allowing for rise in the cost of materials and in wage rates, further allowances should be made for decreased labor efficiency, for possible need for overtime, for increased overhead expenses resulting from delays occasioned by labor shortage, and for uncertain deliveries of materials and equipment.

For judging the amount to be allowed for these contingencies, not much is available but the record of construction cost of the boom period following World War I.

The purpose of an estimate should be to give the owner one's best opinion (or guess, if you please) as to the amount of money the estimator would earmark for the project, were it his own. Our company charts an index for our guidance, which represents the best opinion we can form from our experience and other sources as to current costs, to which we add, from time to time, our best judgment (or guess) as to where building costs will be, say six months from now. As you will see, just now we are using an index of approximately 375.

MORTON C. TUTTLE
Boston, Mass.

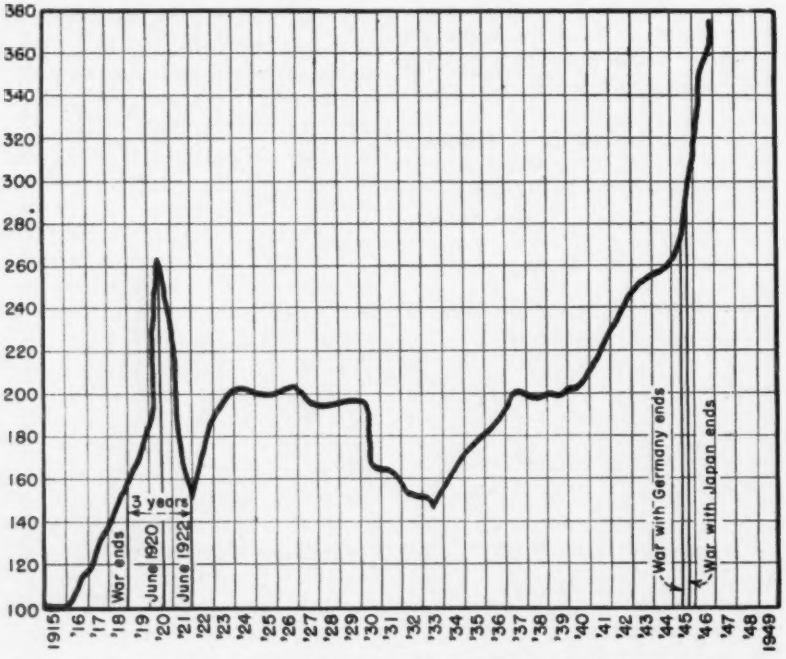
Not a Profession

Sir: It was with a great deal of interest that I read the news item about the shortage of highway engineers in the issue of Aug. 15, vol. p. 208, and the letter of Christopher Krettecos of Alameda, Cal. on the same subject (*ENR* Sept. 19, vol. p. 392). The attitude of consultants—"faithful practitioners of a learned profession"—together with the "shrewd operator" known as the contractor has attracted the attention of the writer for many years. The "dime a dozen" sneer directed at the engineer has resulted in the abandonment of the profession by many good men and their absorption into lines of endeavor where they have proven far more successful.

Engineering schools report a decrease in civil engineering enrollments, and why not? What man of any character can be expected to work on a project where the laborer and crane operator enjoy pay that must seem to the engineer fabulous? For my part I fought for a decent pay-scale as long as possible. It was only when three engineering societies gave me to understand that such remarks were not "ethical" that I resigned from them all and branched out into the practice of safety engineering in heavy construction—and quite to my distinct gain.

The engineer is too *proud* to join a union? It is not that he is too proud; he is too stupid and is forever dazzled with the platitudes of the "faithful practitioner of a learned profession" that engineering is on a par in dignity with medicine and the law. While I hold two licenses as a civil engineer and one as a registered land surveyor, I deny that engineering is a profession (except for a very few); the rest of us are just specialized workmen who have not the sense to act as good workmen in our own interests.

WILLIAM STACK
Safety Engineer on Heavy Construction
Ocala, Fla.



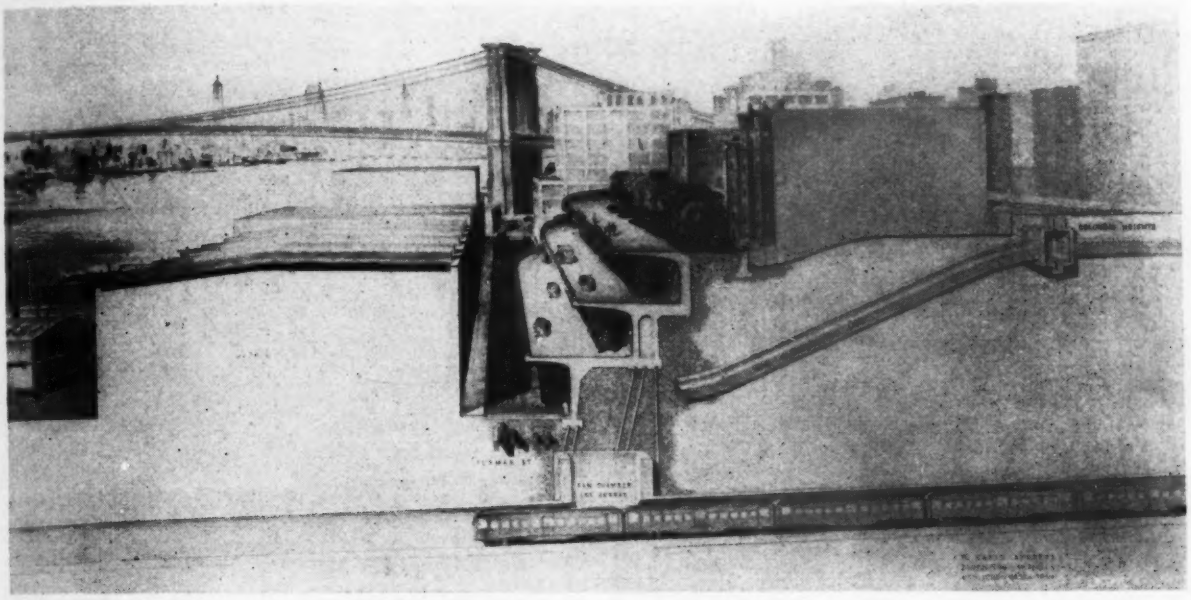
Construction cost index developed and used by the Morton C. Tuttle Co. of Boston.

Clarification

Sir: In Fig. 12 and 13 of my article, "Circles of Stress and Strain." (*ENR* Sept. 19, vol. p. 376) the shearing strain is shown as ϵ_s. This is the *angular* strain of the plane at the point. Since the perpendicular plane is also strained, the angular strain of one plane relative to the other is twice ϵ_s. This explanation was inadvertently omitted from the article.

J. CHARLES RATHBUN
Professor of Civil Engineering
City College of New York

UNIT PRICES BID BY CONTRACTORS



Brooklyn-Queens Connecting Highway, Joralemon St. to Middagh St., Brooklyn, New York

OWNER: City of New York, Office of the President of the Borough of Brooklyn, Otto Clausner, Chief Engr., Bureau of Highways and Sewers; Andrews & Clark, New York, N. Y., Consulting Engineers.

PROJECT: Construction of portion of Brooklyn-Queens Connecting Highway from a line about 105 ft. north of Joralemon St., running north on Furman St. to Pineapple St., then diagonally east to a line about 40 ft. north of Middagh St. Work consists of demolishing and removing buildings and appurtenances, grading, paving, constructing walls, viaducts, bridges, and utilities, including sewers, drainage, water mains, and lighting.

CONDITIONS: In order to preserve the industrial and commercial waterfront usage of Furman St., and the residential usage of Columbia Heights, which is located on a steep hillside, it is necessary that the highway be of triple-deck construction. Above a street-level service road, two express highways are to be cantilevered, and a promenade and park will be superimposed above. The lower highway will have an overhang of only 15½ feet, whereas the top bench supporting the promenade will have an overhang of 23½ ft. The route passes over many complicated underground utilities, including subway tubes, ventilating shafts, sewers, utility ducts, water mains, and other underground services.

If possible, demolition of the structures along Furman St. should be commenced first so that foundation and subsurface conditions will be exposed for examination by the contractor and the engineer. Tenants of the buildings facing Columbia Heights and Middagh and Willow Sts. may be permitted to remain 90 days after contract award so that demolition of those buildings may be delayed. The Montague St. section of the viaduct should also be started immediately. Rerouting of the cables of the Board of Transportation and public utility companies through the new structure must be accomplished while existing services are maintained. The Clark St. section of the viaduct also presents a similar problem. A minimum of interference with traffic must be maintained during utility and viaduct work. At least one-half of the roadways where work is not in progress must be kept clear at all times. Contractor must maintain in good condition the asphalt pavement for three years, and the granite pavement, concrete curb, concrete sidewalks, and all planting for one year after contract completion. Contract time is 720 calendar days. Failure to meet completion date will result in the assessment of liquidated damages of $500 per day. Wage rates are $2.50 per hour for power-driven shovel operating engineers, $2.25 for structural ironworkers, $2.10 for carpenters, $2.00 for electricians, $1.75 for concrete and curb form setters, $1.50 for cast iron or steel pipe layers, $1.40 for structural welders, and $0.95 for common labor.

BIDS: Three bids were received June 26, 1946, ranging from the contract low of $5,835,750 to $7,231,125. The low bid is 58 percent above the engineer's estimate of $3,692,000.

LIST OF BIDDERS:

1. Del Balso Const. Corp., New York, N. Y.	$5,835,750
2. P. J. Carlin Const. Co., Inc. and P. T. Cox Const. Co., Inc., New York, N. Y.	6,776,605
3. Charles F. Vachris, Inc., Brooklyn, N. Y.	7,231,125

Brooklyn-Queens Connecting Highway

(Continued from preceding page)

	Item	Quantity	Unit Prices (1)	(2)	(3)
1.	Clearing and grubbing	lump sum	$15,000.00	$25,000.00	$60,000.00
2.	Unclassified excavation	110,000 cu. yd.	5.00	6.00	4.50
3.	Embankment in place	34,000 cu. yd.	.50	.75	2.85
7A.	Perforated vitrified pipe—6"	6,700 lin. ft.	1.00	1.20	.95
8A.	Vitrified sewer pipe—6"	200 lin. ft.	3.50	3.40	2.35
8B.	Vitrified sewer pipe—12"	750 lin. ft.	6.00	7.60	6.00
8C.	Vitrified sewer pipe—15"	2,000 lin. ft.	7.00	9.80	6.25
8D.	Vitrified sewer pipe—18"	20 lin. ft.	10.00	12.00	11.25
8E.	Vitrified sewer pipe—24"	250 lin. ft.	12.00	14.50	12.50
9B.	Concrete sewer—36"	600 lin. ft.	25.00	60.00	50.00
9D.	Concrete sewer—48"	300 lin. ft.	75.00	110.00	100.00
10A.	Cast iron sewer pipe—6"	1,300 lin. ft.	5.00	6.00	6.00
10B.	Cast iron sewer pipe—8"	750 lin. ft.	6.00	14.00	13.00
10C.	Cast iron sewer pipe—12"	130 lin. ft.	10.00	15.00	9.75
10E.	Cast iron sewer pipe—18"	70 lin. ft.	15.00	150.00	53.00
10F.	Cast iron sewer pipe—24"	70 lin. ft.	20.00	175.00	61.00
10G.	Cast iron sewer pipe—4"	120 lin. ft.	4.00	6.00	2.00
10H.	Cast iron sewer pipe—14"	20 lin. ft.	15.00	25.00	7.50
10J.	Cast iron sewer pipe—16"	20 lin. ft.	20.00	30.00	15.00
11.	Portland cement	98,500 bbl.	2.50	3.00	2.95
12.	High early strength cement	100 bbl.	4.00	4.50	4.40
13.	White portland cement	700 bbl.	7.00	8.00	9.00
14.	Natural cement	600 bbl.	3.00	4.00	3.60
15.	Structural concrete, 1:2:3½	53,400 cu. yd.	25.00	30.00	31.00
16.	First class concrete, 1:2:4	450 cu. yd.	25.00	35.00	33.00
17.	Second class concrete, 1:2½:5	4,200 cu. yd.	25.00	25.00	26.50
18.	Granite masonry	210 cu. yd.	300.00	350.00	450.00
19.	Granite veneer	102,000 sq. ft.	4.50	4.25	4.75
22.	Metal reinforcement for pavement	1,200 sq. yd.	.50	.75	.65
23.	Steel fabric reinforcement	82,000 lb.	.15	.10	.11
24.	Bar reinforcement	7,000,000 lb.	.08	.095	.09
25.	Structural steel	1,030,000 lb.	.15	.16	.19
26.	Miscellaneous iron and steel	105,000 lb.	.20	.20	.14
28.	Concrete foundation for pavement	2,000 cu. yd.	8.50	10.00	13.00
29.	Sheet asphalt pavement	3,000 sq. yd.	1.40	1.30	1.75
32.	Colored cement concrete pavement, 1:1.75:3.5	2,500 cu. yd.	10.00	18.00	20.00
33.	Granite block pavement	8,600 sq. yd.	5.00	7.50	8.70
34A.	Granite curb, type A	1,000 lin. ft.	5.50	5.75	8.70
35A.	Bluestone curb, type A	2,300 lin. ft.	3.50	4.50	6.20
36A.	Pipe railing—1¼"	100 lin. ft.	4.50	6.50	8.25
37.	Concrete curb	500 cu. yd.	20.00	36.00	45.00
38A.	Reset old curb, type A	2,000 lin. ft.	2.50	2.95	5.00
40B.	Metal rail, type MB	420 lin. ft.	18.00	18.00	23.50
40C.	Metal rail, type MC	5,200 lin. ft.	15.50	18.00	21.00
40E.	Metal rail, type ME	2,000 lin. ft.	25.00	28.00	32.50
43.	Screened gravel	100 cu. yd.	6.00	7.50	6.50
44.	Bagged screened gravel	4,400 cu. yd.	7.00	11.00	14.00
45.	Joint supports	200 ea.	.75	.50	.60
46.	Bituminous material waterproofing	1,200 gal.	.75	.80	.75
47.	Membrane waterproofing—3 ply	20,000 sq. yd.	2.00	2.25	2.40
47A.	Membrane waterproofing—5 ply	100 sq. yd.	4.00	5.00	5.00
48.	Membrane waterproofing—prot. course, 3 ply	22,000 sq. yd.	3.50	3.30	3.65
49.	Timber sheet piling	2 M ft. BM	250.00	400.00	325.00
50.	Steel sheet piling	52,000 lb.	.10	.10	.09
51.	Temporary steel sheet piles	108,000 sq. ft.	.25	1.50	1.60
52.	Temporary sheeting and bracing	40 M ft. BM	200.00	200.00	135.00
53.	Permanent sheeting and bracing	10 M ft. BM	250.00	275.00	230.00
54.	Timber piles	4,200 lin. ft.	1.50	3.00	1.55
55.	Creosoted timber piles	500 lin. ft.	2.00	5.00	2.35
56.	Timber test piles	100 lin. ft.	10.00	10.00	12.50
57.	Concrete test piles	600 lin. ft.	15.00	16.00	25.00
59A.	Cast-in-place concrete piles—8" tip	38,000 lin. ft.	3.00	3.30	5.00
59B.	Cast-in-place concrete piles—12" tip	59,000 lin. ft.	3.50	3.30	6.75
59C.	Cast-in-place concrete piles—10" tip	3,500 lin. ft.	3.50	3.30	5.85
60.	Load test for piles	2 ea.	750.00	1,000.00	750.00
61.	Load test for soils	2 ea.	1,000.00	600.00	500.00
63.	Emulsified carbon black	28,000 lb.	.10	.07	.11
64.	Concrete sidewalk	4,500 sq. yd.	3.00	4.00	5.10
65B.	Drop inlets, type B	24 ea.	250.00	175.00	142.00
65H.	Drop inlets, type H	1 ea.	250.00	200.00	180.00
66A.	Catch basins, type A	5 ea.	350.00	350.00	505.00
66B.	Catch basins, type B	1 ea.	350.00	350.00	540.00
67B.	Sewer manholes, type B	8 ea.	300.00	250.00	345.00
67C.	Sewer manholes, type C	2 ea.	350.00	250.00	435.00
67D.	Sewer manholes, type D	22 ea.	350.00	500.00	550.00
67E.	Sewer manholes, type E	4 ea.	350.00	250.00	250.00
67F.	Sewer manholes, type F	1 ea.	350.00	300.00	600.00
67G.	Sewer manholes, type G	2 ea.	450.00	300.00	350.00
67K.	Drop manholes	3 ea.	10,000.00	8,000.00	6,650.00
68B1.	Steel pipe conduit, 1⅓"	50 lin. ft.	1.50	.80	2.10
69A.	Remove and reset fire alarm posts	1 ea.	50.00	40.00	200.00
69B.	Wrought iron pipe conduit, 3"	900 lin. ft.	2.50	3.60	4.35
69C2.	Furn. install F. A. Cable, 8-wire	1,200 lin. ft.	1.60	1.50	3.00
69D.	Fire alarm manhole	5 ea.	350.00	300.00	265.00
69F.	Cast iron pull box, 18" x 18" x 12"	1 ea.	150.00	130.00	150.00
69T.	Temporary fire alarm facilities	lump sum	10,000.00	1,500.00	7,000.00
70A.	Temporary light pole	24 ea.	150.00	200.00	350.00
70B.	Temporary overhead wire	10,000 lin. ft.	.60	.10	.15
70C.	Temporary barricade lighting	20 ea.	350.00	750.00	590.00
70D.	Unit change of barricade lighting	20 ea.	200.00	75.00	33.50
70G1.	Furnish & install lighting standards & luminaires, type 418	7 ea.	525.00	700.00	540.00
70G3.	Furnish & install lighting standards & luminaires, type B	38 ea.	225.00	250.00	295.00
70H.	Install lighting standards	28 ea.	125.00	100.00	160.00
70J1.	Luminaires, type A (bridge underdeck)	118 ea	90.00	85.00	105.00
70J2.	Luminaires, type E (bridge underdeck)	66 ea	75.00	70.00	95.00
70P1.	Concrete service boxes, type 1	18 ea	75.00	80.00	115.00
70P2.	Concrete service boxes, type 2	11 ea.	100.00	120.00	175.00
70P4.	Concrete service boxes, type 4	2 ea.	125.00	140.00	225.00
70R4.	Cast iron pull boxes, 16" x 16" x 12"	38 ea.	150.00	130.00	260.00
70R9.	Cast iron pull boxes, 36" x 18" x 16"	3 ea	400.00	170.00	580.00
70V.	Control cabinets, 3 relays	3 ea.	1,300.00	750.00	875.00
70V1.	Control cabinets, 6 relays	1 ea.	1,500.00	1,100.00	2,200.00
70X2.	Steel conduit, 1"	5,500 lin. ft.	.80	.60	1.35
70X3.	Steel conduit, 1¼"	2,400 lin. ft.	.85	.80	1.45
70X4.	Steel conduit, 1½"	2,250 lin. ft.	1.50	.90	1.85
70X5.	Steel conduit, 2"	1,500 lin. ft.	1.75	2.10	2.50
70X6.	Steel conduit, 3"	3,500 lin. ft.	2.50	2.60	3.00
70X7.	Steel conduit, 4"	6,700 lin. ft.	3.50	3.70	5.50
70Y4.	Furnish & install conductor, # 6 B & S, bare	600 lin. ft.	.15	.20	.22
70Y6.	Furnish & install conductor, # 2 B & S, bare	850 lin. ft.	.20	.40	.27
70Y7.	Furnish & install conductor, #2/0 B & S, bare	3,000 lin. ft.	.35	.30	.33
70Y8.	Furnish & install conductor, #4/0 B & S, bare	350 lin. ft.	.65	.40	.44
70Z1.	Furnish & install conductor, #12 B & S, RCL	18,000 lin. ft.	.20	.20	.20
70Z4.	Furnish & install conductor, #6 B & S, RCL	1,500 lin. ft.	.35	.45	.72
70Z6.	Furnish & install conductor, #2 B & S, RCL	3,000 lin. ft.	.60	.75	.78
70Z7.	Furnish & install conductor, #2/0 B & S, RCL	8,000 lin. ft.	.80	.75	.87
70Z8.	Furnish & install conductor, #4/0 B & S, RCL	1,000 lin. ft.	1.00	1.10	1.15
70AA.	Astronomical time switches	28 ea.	50.00	50.00	38.00
71A1.	Furnish & lay steel water pipe, 12"	120 lin. ft.	30.00	30.00	24.00
71B1.	Furnish & lay steel water pipe encased, 12"	110 lin. ft.	30.00	35.00	28.50
71C1.	Furn. & lay c. i. water pipe, 6"	80 lin. ft.	10.00	12.00	11.50
71D2.	Remove cast iron water pipe, 12"	2,500 lin. ft.	4.00	4.50	6.70
71E2.	Lay cast iron water pipe, 12"	200 lin. ft.	3.80	4.50	8.40
71F1.	Furnish & install valves, 6"	1 ea.	100.00	100.00	125.00
71G.	Remove hydrant assemblies	9 ea.	60.00	100.00	195.00
71H.	Install hydrant assemblies	2 ea.	150.00	200.00	225.00
71J.	Rem. high press. hydrant assem.	14 ea.	100.00	150.00	260.00
71K.	Install high press. hydrant assem.	12 ea.	250.00	300.00	500.00
71L3.	Furnish & lay high pressure cast iron water pipe, 20"	500 lin. ft.	30.00	35.00	48.75
71M1.	Remove high pressure cast iron water pipe, 12"	150 lin. ft.	4.25	5.00	7.50
71M3.	Remove high pressure cast iron water pipe, 20"	2,200 lin. ft.	5.00	6.00	11.00
71N1.	Install high pressure cast iron water pipe, 12"	100 lin. ft.	5.50	6.00	6.30
71N3.	Install high pressure cast iron water pipe, 20"	1,800 lin. ft.	6.25	6.50	13.00
71P1.	Furnish & install high pressure valves, 12"	1 ea.	750.00	750.00	900.00
71P3.	Furnish & install high pressure valves, 20"	2 ea.	1,800.00	2,000.00	2,700.00
71S.	Reset existing hydrant	6 ea.	80.00	100.00	440.00
71U2.	Install valves, 12"	1 ea.	75.00	100.00	95.00
71X3.	Install high pressure valves, 20"	6 ea.	300.00	400.00	375.00
71Z.	Furnish & install air cocks	2 ea.	100.00	100.00	80.00
73.	Cinders	50 cu. yd.	5.00	3.00	3.75
78.	Park benches	100 lin. ft.	10.00	8.00	8.75
79.	Stone block pavement	500 sq. yd.	5.00	4.00	8.75
83.	Sewer risers	50 lin. ft.	5.00	20.00	8.75
84.	Adjust manhole and basin heads	3 ea.	25.00	50.00	50.00
94.	Pile shoes	200 ea.	5.00	2.50	2.00
96A.	Steel H piles, 12" x 74 lb	1,100 lin. ft.	4.50	5.00	7.00
96B.	Steel H piles, 14" x 102 lb	66,000 lin. ft.	4.50	6.00	7.20
97A.	Maintain, protect & revise transit facilities	lump sum	50,000.00	40,000.00	40,000.00
97D3.	New duct line, 12 ducts	150 lin. ft.	20.00	10.00	13.75
97D6.	New duct line, 24 ducts	200 lin. ft.	30.00	15.00	20.00
97E.	Remove cable	5,300 lin. ft.	1.00	1.20	2.70
97G2.	Furnish & install cable, 500,000 CM	2,300 lin. ft.	2.00	2.10	3.40
97G4.	Furnish & install cable, 250,000 CM	500 lin. ft.	2.00	1.30	2.15
97G6.	Furnish & install cable, telephone, 124 pair—quad. type	500 lin. ft.	2.50	1.60	5.10
97G7.	Furnish & install cable, telephone, 100 pair—(80–#19 & 20–#16)	1,000 lin. ft.	2.25	1.80	4.90
97G8.	Furnish & install cable, 18 conductor (5–#10 & 13–#16) R. I. L. C.	1,500 lin. ft.	1.50	1.70	2.00
97G9.	Furnish & install cable, 3 conductor #6 shielded P. I. L. C.	500 lin. ft.	3.00	3.60	23.00
97G10.	Furnish & install cable, #4/0 R. C. L. C. 600 v	800 lin. ft.	1.00	1.40	2.30
97G11.	Furnish & install cable, 2 conductor (200,000 CM & 750,000 CM) P. I. L. C.	500 lin. ft.	16.00	9.00	19.75
97G12.	Furnish & install cable, 2,000,000 CM P. I. L. C.	300 lin. ft.	10.00	7.50	16.50
97G13.	Furnish & install cable, #4/0 P. I. L. C.	100 lin. ft.	2.50	3.50	12.50
97G14.	Furnish & install cable, 3 conductor #3/0 shielded P. I. L. C.	50 lin. ft.	12.00	6.50	26.00
97G15.	Furnish & install cable, 3 conductor #4/0 shielded P. I. L. C.	250 lin. ft.	12.00	6.50	27.00
97G16.	Furnish & install cable, 14 conductor, #14 R. I. L. C.	50 lin. ft.	5.00	7.00	21.00
97G17.	Furnish & install cable, 20 pair, #19 solid P. I. L. C.	50 lin. ft.	4.00	4.00	25.00
97G18.	Furnish & install cable, 90 pair, #19 solid P. I. L. C.	50 lin. ft.	8.00	6.20	26.00
97G19.	Furn. & install cable, 4 cond. #4/0 R. I. L. C. (Neoprene sheath)	50 lin. ft.	15.00	12.00	27.00
97H2.	B. of T. manholes, type K	2 ea.	750.00	1,500.00	1,750.00
97J.	Alter B. M. T. manholes	2 ea.	1,000.00	900.00	1,100.00
97K.	Pull boxes, 36" x 36" x 12"	1 ea.	350.00	330.00	185.00
98.	Concrete guide railing	160 lin. ft.	20.00	15.00	10.00
100.	Demolition	lump sum	250,000.00	264,000.00	200,000.00
101.	Stone masonry	750 cu. yd.	100.00	115.00	130.00
102.	Hexagonal block surfacing	2,500 sq. yd.	4.00	4.00	7.50
103.	Bluestone surfacing	3,000 sq. yd.	16.00	13.00	15.50
104.	Timber and lumber	10 M ft. BM	200.00	250.00	250.00
105.	Creosoted timber and lumber	2 M ft. BM	300.00	450.00	350.00
109.	Underpinning	lump sum	150,000.00	150,000.00	25,000.00
112.	Alteration to subway vent building	lump sum	125,000.00	100,000.00	100,000.00
121.	Alteration of Clark St. vent. shaft	lump sum	15,000.00	25,000.00	21,000.00
123.	Louvres-Montague St. vent. bldg.	lump sum	25,000.00	30,000.00	32,000.00
129.	Steel H test piles	200 lin. ft.	10.00	20.00	25.00
133.	Cement grout	20 cu. yd.	30.00	30.00	25.00
135.	Pavement cores	15 ea.	20.00	52.00	50.00

give them *Longer Life* *with* U·S·S STEEL BEARING PILES

With the exception of 3" x 10" timber fenders, this mooring dolphin is of all steel construction, U·S·S Bearing Piles being used for all braces as well as for piling. On large jobs and small, in fresh and salt water, you can't beat steel for safety and economy.

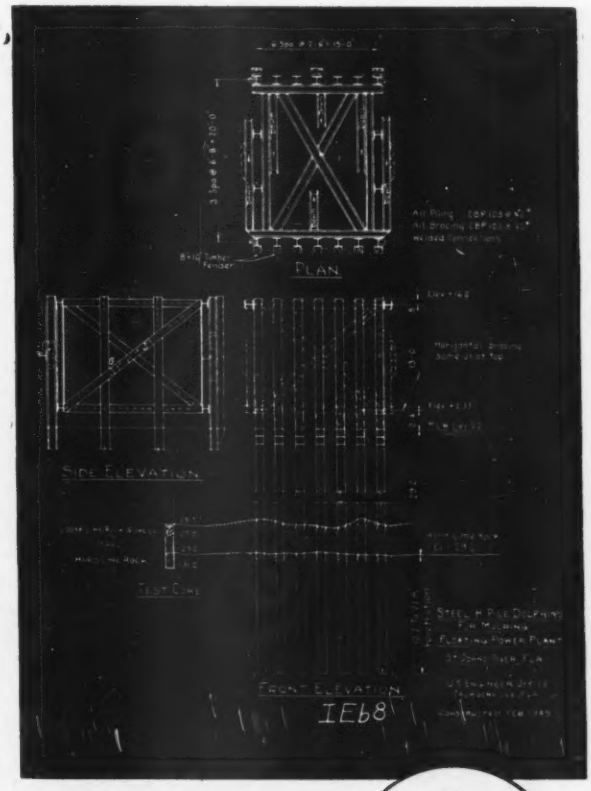
EXAMPLE 1. Shown at left, is a combination wood and steel dolphin as used to protect refinery docks at the Atreco, Texas, Terminal of the Atlantic Refining Company.

The buffer and fender value and service life of this 19 wood-pile cluster is increased many times over by the addition of 3 steel batter piles. The unique plate and cable method of securing the 3 batter piles to the wood cluster permits the dolphin to "give", while the triangular arrangement of the steel bearing piles provides extra, firmer anchorage for the cluster. Designed by Lester M. Goldsmith, Chief Engineer, Atlantic Refining Company.

Example 2. Illustrated at the right, is an all-steel H-pile dolphin designed and constructed by U. S. Engineers for mooring a floating power plant in the St. John's River, near Jacksonville, Florida. Providing valuable protection against high water and scour, these easily driven steel piles are highly resistant to extraction.

Whether conditions are usual or out-of-the-ordinary, U·S·S Steel Bearing Piles provide a safe, economical means of supporting foundations or absorbing shock. Their capacity for high unit loads, both vertical and horizontal, means fewer piles and fewer driving operations for a given load.

For detailed information on U·S·S Steel Bearing Piles and other U·S·S Engineering Products, please contact the office nearest you.



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New Aids to the Constructor

MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Aluminum Shingles, Roofing and Prefab Buildings —Shingles, sheet roofing and several types of prefabricated buildings are now being manufactured from aluminum. The interlocking aluminum shingles are made from .019 gage Alcoa roofing sheet, plain or factory-painted in a choice of three colors; the finish is said to be exceptionally fade-resistant and durable. The aluminum roofing never requires painting, needs little if any maintenance and is an excellent reflector of heat and light.

The all-aluminum house weighs 970 lb., packed for export. Sides and roof are .019 gage aluminum sheets with 61-st. alloy wall angles, and it is mounted on a 3-in. concrete base. Measuring 19 x 9½ ft., it is divided into two rooms, with aluminum windows and doors. A sanitary aluminum latrine is available, weighing only 30 lb. packed for shipment.—*Southern States Iron Roofing Co., Savannah, Ga.*

Hydraulic Bulldozer — Named "Imp," a new, small hydraulic bulldozer is entirely front-mounted, simple to install and easily transported from job to job. Lifting, lowering, floating and hold positions are all hydraulically controlled from single lever. It has reversible cutting edge, rigid moldboard and push arms and is so constructed that underframe mounting allows for minimum width of cut. All thrusts are transmitted to drawbar connections. Combined with Cletrac Model HG-42, its light weight and positive traction enable unit to operate effectively on soft terrain.—*The Oliver Corp., Cleveland, Ohio.*

All-Position Electrode — The new Airco No. 87 electrode is a general purpose, mild steel electrode operating well on D-C straight or reverse polarity and on A-C, producing a weld metal of high mechanical properties. It is especially recommended for low-cost, single- or multiple-pass welding on plates or sections where the fit-up is poor, or the work is rusty or dirty.

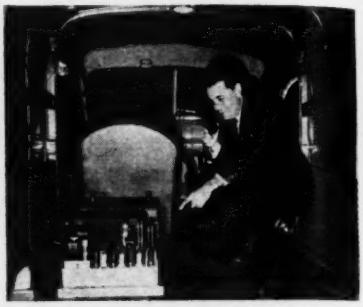
This extruded-coated rod is now available in quantities and offers the following advantages: Production of excellent welds over wide current ranges for any given diameter; characteristic the same when using D-C straight polarity, D-C reverse polarity or A-C; excellent results in all positions; high deposition rate and efficiency.—*Air Reduction Sales Co., 60 East 42d St., New York 17, N. Y.*

Adjustable Shore — The two telescoping parts of the Rite-Angle shore

are made up of light, bar size steel angles and flat steel bands; they may be extended to desired lengths and secured by a simple through-pin. An ordinary swivel unit secured to the base and a threaded head unit permit merely turning the main shaft by hand to produce plus or minus adjustments for positive fractional changes, eliminating a jacking device. The entire unit is nearly 30 percent lighter in weight than other articles of this nature, with a loading range from 10,000 lb. closed, to 4,000 lb. fully extended. When turning the shaft by hand for final adjustment, a lifting power is easily attained up to 4,000 lb.

Present shores are made of steel, but will soon be available in aluminum, or in a combination of steel and aluminum. —*Steel Forms, Inc., 207 Van Brunt St., Brooklyn 31, N. Y.*

Drifters and Stopers — Manufactured in three sizes, 3-, 3½- and 4-in. cylinder diameters, either may be mounted as hand crank machine, Model WHC; air-motor-driven unit with motor attached to guide shell, Model WPMS; or with the air motor attached to the back head of drifter, Model WPM. Width of all cylinder ways is same on all sizes and models and each size drifter uses the same guide shell. Worthington Pneu-Motor is of six-vane rotary type with simple spur gears. Also new is Blue Brute self-rotating stoper, Model WR-31, for use in mining operations.—*Worthington - Ransome Construction Equipment Division, Holyoke, Mass.*



Radio Telephone—Mobile radio telephone equipment in a truck enables a driver to make and receive local and long distance telephone calls to and from any Bell system or connecting telephone unit in the United States or overseas. The new service is an application of frequency modulation radio principles; equipment consists of a receiver, transmitter, antenna, selective signaling device, instrument holder and hand set. Conversations travel part way by radio and part way by telephone lines.

An amber light and bell under the dashboard of the truck indicate when the telephone operator is attempting to contact the truck. The equipment may also be used in ship-to-shore conversations. — *Bell Telephone Laboratories, New York, N. Y.*

Moisture Meter for Sand—A meter for determination of free moisture in concrete sand embodies new principles and procedures. The device is electrically operated and has a specially de-

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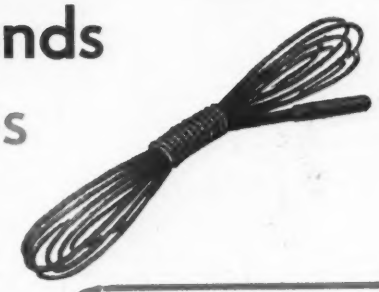
EXPLOSIVES

Efficient Tunneling demands the proper explosives properly used



After selecting the proper blasting agents for rock removal, and loading of holes, great care should be taken in the proper connection of the electric firing devices. Misfired holes are both dangerous and expensive.

The AMERICAN explosives and blasting accessories used in construction work are the products of intensive research, chemical control, thorough inspection, and unremitting care in manufacture. They have proved their merit by years of satisfactory service. There is a grade fitted to any problem in blasting.

● Capable field engineers are available at your call.

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FORMULA No. 640

a clear liquid waterproofing for old or new construction

PENETRATES

deeply—one inch or more—is not a surface treatment. Brush, spray, or float on stone, cast stone, concrete, mortar, stucco, tile, brick, plaster, wood, wall board — any absorbent material.

WATERPROOFS,

preserves, prevents dusting of floors, surface dirt washes away in rain.

FORMULA No. 640

is a balanced formula of seven different waxes and resins in a hydrocarbon solvent.

ACID-ALKALI proof

does not oxidize, unchanged by temperature.

PERMANENCE

it is our opinion it will last as long as the concrete, mortar, stucco, etc. lasts.

OIL PAINT

saponifies on cement unless sealed first with Formula No. 640.

APPLY to either side:

The pressure side, or opposite side —it is equally effective.

HYDROSTATIC PRESSURE

a 20 foot head has been held by Formula No. 640.

CUTS WATERPROOFING COSTS

because it applies three times as fast as paint, requires no special technique.

No preparation — comes ready to apply.

Eliminates necessity of furring. Concrete floors and walls need no membraning.

Keeps in all climates
Harmless to use
Good coverage
Moderate price

Write our Engineering Department for office test kit, technical data, or regarding any special problem.

J. Wilbur Haynes, Engineer

OTHER PRODUCTS: Formula No. 640 Toxic, combines waterproofing with termite and fungus protection; cement hardener; floor mastic; roof coatings, etc.

HAYNES PRODUCTS CO.
4007 Farnam St.,
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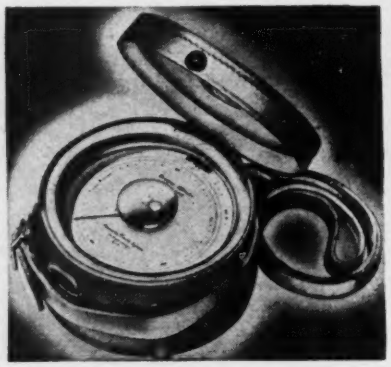
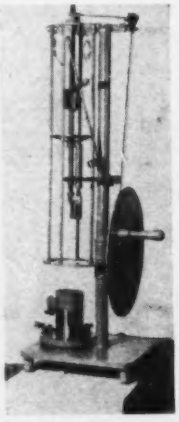
signed "prod" or pick-up that is merely inserted in the sand to obtain a reading. It is a constant-operating device,—the prod can be mounted in the batching hopper, the meter needle indicating the per cent of free moisture continuously. Installation is not difficult; the user standardizes his meter for the particular sand he is using, and once set it requires no further calibration for that one specific quality or type of sand.—Manufactured by *J. Thos. Rhamstine*, it is nationally distributed by the *Valley Ready-Mix Concrete Co., Harlingen, Texas.*



Surveying Altimeter—Great accuracy and sensitivity are claimed for the new SA series of surveying altimeters, made in several models to cover all ranges of elevation above and below sea level. The instrument is rugged and comes encased in a leather carrying case with hand and shoulder straps, and weighs 2 lb. In this device diaphragm movement is directly and without friction read in terms of inches pressure or feelt altitude on the dial.—*American Paulin System, Los Angeles, Cal.*

Automatic Tamper — Designed for preparing compacted soil specimens under the standard Proctor test, the modified Proctor test, the California bearing ratio test and other tests, a versatile tamper automatically spaces all blows in accordance with the presetting; it automatically releases a 5.5 lb. or 10 lb. hammer for an accurate 12 or 18 in. free-falling drop, as may previously be selected; and automatically counts all blows. All settings may be duplicated. The specimen molds do not rotate and are solidly clamped



Worthington-Ransome Blue Brute Distributors

See ad on page 147 for list of equipment in each line

Worthington-Ransome Distributors

Ala., Birmingham Construction Equip. Co.
Ala., Montgomery, Burford-Toothaker Tractor Co.
Alaska, Anchorage, Airport Mac. & Storage Co.
Ariz., Phoenix, Lee Redman Equip. Co.
Cal., San Francisco, Coast Equip. Co.
Cal., Los Angeles, Golden State Equip. Co.
Colo., Denver, Power Equipment Company
Conn., New Haven, Wilhelm-Davies Co., Inc.
Fla., Miami, Allied Equip., Inc.
Fla., Orlando, Highway Equip. & Supply Company
Tampa, Epperson & Company
Ga., Atlanta, Tractor & Machinery Company
Ida., Boise, Olson Manufacturing Company
Ill., Chicago, Chicago Construction Equipment Co.
Iowa, Cedar Rapids, McNall Machy. & Supply Co.
Ky., Harlan, Croushoan Equip. & Supply Co.
Maine, Portland, Maine Truck-Tractor Company
Mass., Allston, Boston, Clark-Wilcox Co.
Mich., Muskegon, Lakeshore Machy. & Supply Co.
Minn., Minneapolis, Phillippi-Murphy Equip. Co.
Miss., Jackson, Jackson Road Equip. Co.
Mo., Clayton, The Howard Corporation
Montana, Billings, Interstate Truck & Equip. Co.
Helena, Caird Eng. Works
N. C., Raleigh, Smith Eqpt. Co.
N. J., No. Bergen, American Air Compressor Corp.
N. M., Albuquerque, Bud Fisher Co.
N. M., Roswell, Smith Machy. Co.
N. Y., Albany, Milton-Hale Machinery Company
New York, Hodge & Hammond, Inc.
N. Y., Olean, Freeborn Equip. Co.
N. Y., Syracuse, Milton-Hale Mach. Co.
N. D., Fargo, Smith Commercial Body Works, Inc.
O., Cincinnati, Carroll-Edwards Co.
Okla., Oklahoma City, Townsco Equip. Company
Ore., Portland, Andrews Equip. Service
S. C., Columbia, Smith Equipment Company
Tenn., Knoxville, Dempster Bros., Inc.
Tenn., Memphis, Independent Tractor Co.
Tenn., Nashville, Dempster Bros., Inc.
Tex., Amarillo, T. W. Carpenter Equip. Co.
Tex., Dallas, Shaw Equip. Co.
Tex., Houston, Contractors Equip. Sales & Service Corp.
Tex., San Antonio, Patten Machy. Co.
Tex., Tyler, D. N. McClure Equip. Co.
Utah, Salt Lake City, J. K. Wheeler Mach. Co.
Vt., Barre, A. M. Flanders, Inc.
Wash, Spokane, Andrews Equip. Service
Wisc., Milwaukee, Drott Tractor Co. Inc.

Ransome Distributors

D. C., Washington, M. A. Doetsch Mach. Company
Ill., Chicago, Thomas Hoist Company
Ind., Fort Wayne, American Steel Supply Corp.
Ky., Paducah, Henry A. Petter Supply Company
La., New Orleans, Ole K. Olsen Company
Md., Baltimore, Stuart M. Christhilf & Company
Mich., Detroit, T. G. Abrams
Neb., Lincoln, Highway Equip. & Supply Co.
N. Y., Buffalo, Murray Equip. Co.
O., Cleveland, H B. Fuller Equip Company
Pa., Philadelphia, Giles & Ransome
Pittsburgh, Arrow Supply Company

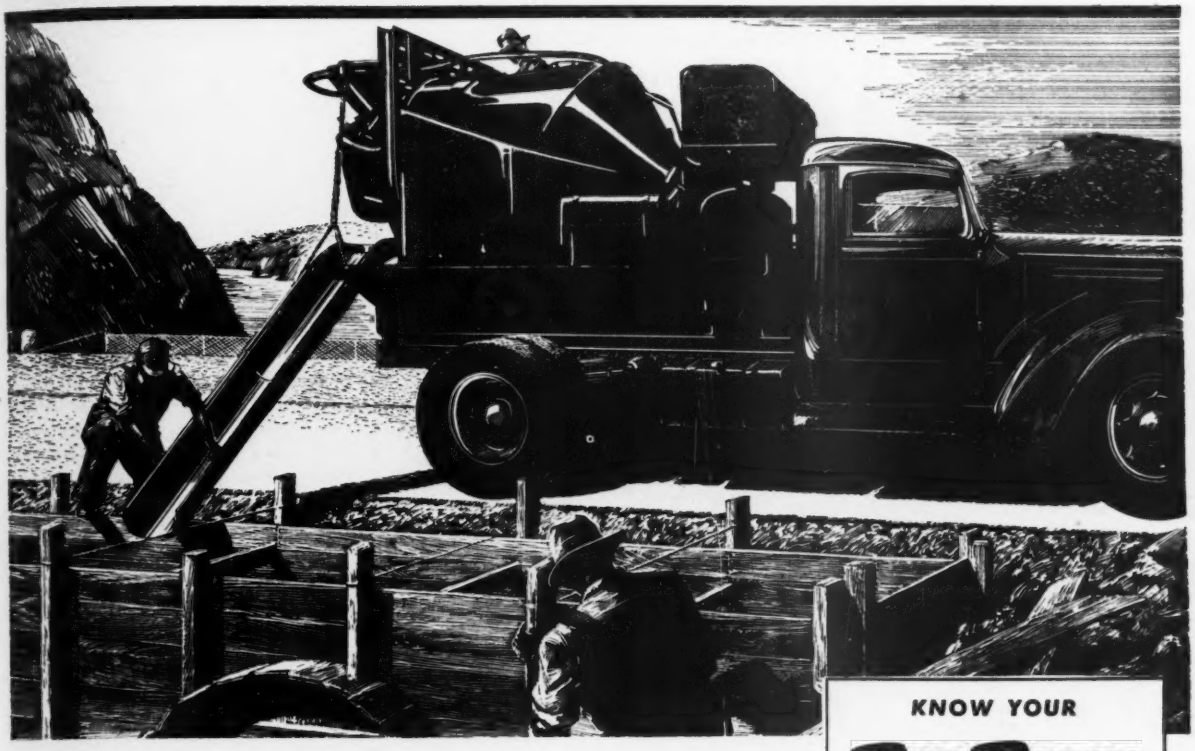
Worthington Distributors

Ark., Fort Smith, R. A. Young & Son
Little Rock, R. A. Young & Son
Ind., Indianapolis, Reid-Holcomb Company
Ky., Louisville, Williams Tractor Company
La., New Orleans, Wm. F. Surzi Equip. Company
Md., Baltimore, D. C. Elphinstone, Inc.
Mass., Cambridge, Field Mach. Company
Mich., Detroit, W. H. Anderson Co., Inc.
Flint, Gransden-Hall & Company
Mo., Kansas City, Mach. & Supplies Co.
N. Y., Buffalo, Dow & Co., Inc.
New York, Air Compressor Rental & Sales
O., Cleveland, Gibson-Stewart Company
Toledo, The Kilcorse Mach. Co.
Pa., Allentown, H. N. Crowder, Jr., Inc.
Easton, Sears & Bowers
Harrisburg, American Equip. Corp.
Oil City, Freeborn Equipment Company
Pittsburgh, Atlas Equip. Corp.
Pa., Phil. Metalweld, Inc.
Wilkes-Barre, Ensminger & Company
Texas, El Paso, Equip. Supply Company
Va., Richmond, Highway Mach. & Supply Co.
Wash., Seattle, Star Machinery Company
Wyoming, Cheyenne, Wilson Equip. & Supply Co.

Buy Blue Brutes

Worthington Pump and Machinery Corp.
Worthington-Ransome Construction Equipment Division
Holyoke, Massachusetts

HI-UP... IN NAME, REPUTATION AND QUALITY



Flexibility, engineered into all Ransome Blue Brute Truck Mixers, reaches its peak in the new Hi-Up. This flexibility eliminates all strains resulting from misalignment while charging, discharging, or operating over uneven ground. The truck mixer is designed so that when discharging is completed, all moving parts return to their normal positions.

The transmission shows a marked advance over usual design. Enclosed water pump clutch requires no adjustment and at no time is there any need for manual lubrication. A separate engine clutch, two speeds forward and reverse, and multiple disc clutches assure easier starting, a wider performance range and smoother operation.

Other new design details: Unbreakable, anti-freeze gauge glasses, in full view of the operator . . . Quick-charging, unobstructed hopper, with improved sealing door, prevents jamming . . . Positively leak-proof poppet valves with renewable discs — found only in Ransome Truck Mixers . . . Exclusive mixing drum design, with new type spiral blades, for quick charging and fast, clean discharging.

These are but a few of the reasons why the Blue Brute Hi-Up is setting a new high in truck mixer performance — and offering time-saving, trouble-free production of better concrete at lower cost.

Get the whole story from your nearby Worthington-Ransome dealer, or write for Bulletin No. 221.

R6-7

KNOW YOUR

BLUE BRUTES

Your Blue Brute Distributor will gladly show you how Worthington-Ransome Blue Brute Hi-Up Truck Mixers and other construction equipment can put your planning on a profitable basis — and prove that *there's more worth in Worthington*. His name is listed on Page 146. Blue Brutes include:

RANSOME EQUIPMENT

Pavers, Concrete Spreaders and Finishers*, Portable and Stationary Mixers, Pneumatic Placing Equipment, Truck Mixers, Plaster & Bituminous Mixers and Accessories.

WORTHINGTON EQUIPMENT

Gasoline and Diesel Driven Portable Compressors, Rock Drills, Air Tools, Contractors' Pumps* and Accessories.

*To be announced.

BUY BLUE BRUTES

Truck Mixers
Capacities:
2, 3, 4½ cu. yds.

Portable Mixers
Capacities:
3½, 6, 11, 16, 28 cu. ft.

Big Stationary Mixers
Capacities:
28, 56, 84, 126 cu. ft.

Pneumatic Placer
Capacity:
7, 14, 28 cu. ft.

WORTHINGTON

Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division, Holyoke, Mass.

WHEN EARTH MOVING IS THE PROBLEM

Talk it over with your nearest AED Member.

ASSOCIATED EQUIPMENT DISTRIBUTORS — AED MEMBER

The experience of their engineering staff is always available. They know dirt moving costs—they know machinery and what it will do. Part of the service of this great national association of equipment distributors is to help you do every job and do it at a profit.

Why not use the many facilities of

ASSOCIATED EQUIPMENT DISTRIBUTORS

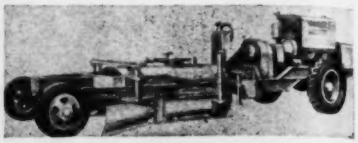
You can be sure of reliable service when you buy from companies displaying this insignia.

ASSOCIATED EQUIPMENT DISTRIBUTORS

BUY SAFELY—
BUY FROM AN AED MEMBER

ASSOCIATED EQUIPMENT DISTRIBUTORS
1928 EYE STREET, N.W.
WASHINGTON 6, D.C.

down to assure accurately controlled compaction. Stock hammers have 3.14 sq. in. face areas with either circular or circle-sector faces and are convertible from 10 lb. to 5.5 lb. Taper bored molds that simplify specimen removal are available.—*Rainhart Co., 602 West 34th St., Austin 21, Tex.*



Traveling Mixing Plant—One-man operated Model 36 Roadmixer is a self-propelled pneumatic tire-mounted traveling mixing plant, designed for maneuverability, speed and capacity. It handles soil cement, tar, cut-back asphalts, and emulsified asphalts, making a thorough mix in one pass. This machine handles up to 4 cu. ft. windrows and produces from 100 to 150 tons of ready-to-spread mix per hour.—*Wood Manufacturing Co., 6900 Tujunga Ave., North Hollywood, Calif.*

Rock Drill—Made of drop forgings throughout, rock drill is 22 in. long and weighs 45 lb. Exhaust ports are arranged to divert exhaust away from operator and are of ample size to prevent freezing in most severe weather. Operated by new-type valve (patented), it can be furnished in dry blower and wet type and for ⅞- or 1 in. steel.—*Schramm, Inc., West Chester, Pa.*

Hard-Facing Electrode—New wear-resistant electrode for hard-facing heavy equipment is fabricated rod consisting of mild steel tubes filled with alloying elements. Deposits are said to bond well with manganese steel and its use is especially recommended on wearing surfaces of all heavy equipment made from this metal. It is available in ¼- and ⅜-in. rod sizes—*Stoody Co., P. O. Box 429, Whittier, Calif.*

Post Hole Drill—Rugged, fast digging and portable earth-boring machine is specially designed for electric pole line jobs and for boring foundation pier holes. Field tests and on-the-job operations have proved its ability to "make a hole" efficiently in all types of hard or clay earths. Inclined or vertical holes

A huff, and a puff ... and you *blow* the roof on. At a real saving in application costs!

Years ago Flintkote introduced the first practical Cold Process Built-up Roof, speeding up application enormously, and eliminating heating equipment dangerous to men, materials and structures. Its superiority has been established, on thousands of roofs, by the acid tests of time and weather.

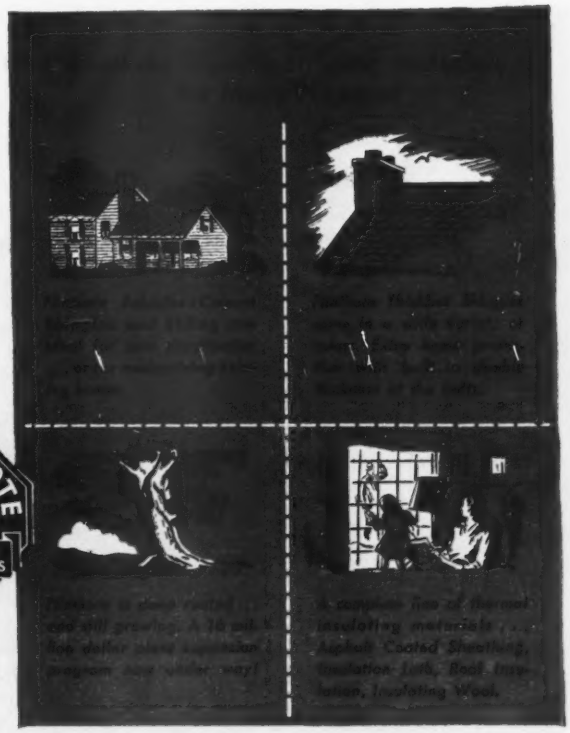
Now, Flintkote pioneers again ... with Cold Process Roofs, both for new construction and for maintenance, APPLIED BY SPRAY.

Now ... with Nu-Static* Roof Coating and Fibrex* II Adhesive designed especially for Spray Application, Flintkote provides an even more rapid, *mechanical* means of assembling what amounts to a "pre-fabricated" roof.

Spray Application has been thoroughly tried and proved. It gives you a glassy-smooth Cold Process Roof. (Far smoother than hand finish.) Saves up to 50 per cent of application costs! And height of building is no limiting factor.

Write for full information on how spray application of Flintkote Cold Process materials results in better roofs at lower application costs. The Flintkote Company, 30 Rockefeller Plaza, New York 20, N. Y. Offices in principal cities.

*Trademark

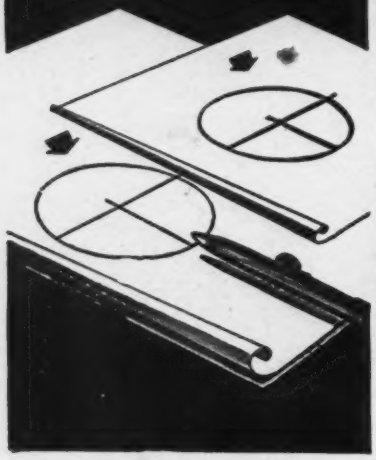


FLINTKOTE
BUILDING MATERIALS

FLINTKOTE

the extra years of service cost no more!

Tracing cloth that defies time



● The renown of Imperial as the finest in Tracing Cloth goes back well over half a century. Draftsmen all over the world prefer it for the uniformity of its high transparency and ink-taking surface and the superb quality of its cloth foundation.

Imperial takes erasures readily, without damage. It gives sharp contrasting prints of even the finest lines. Drawings made on Imperial over fifty years ago are still as good as ever, neither brittle nor opaque.

If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

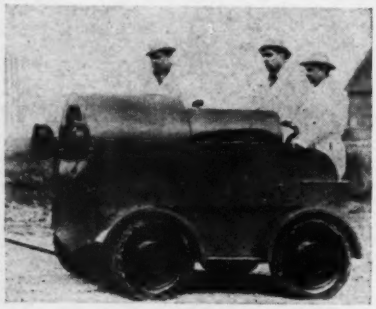
IMPERIAL TRACING CLOTH

SOLD BY LEADING STATIONERY AND DRAWING MATERIAL DEALERS EVERYWHERE

8 to 36 in. dia. and from 1 to 20 ft. in depth, may be drilled cleanly and quickly by one operator.—*Hugh B. Williams Machine Shop, 2946 Oak Lane, Dallas 10, Tex.*

Power-Driven Chain Saw—A new gasoline engine-driven chain saw has 20-in. cutting capacity for one-man operation; 24- and 30-in. cutting capacities for two-man operation. Parts in all sizes are interchangeable.

The saw is built of light weight aluminum or magnesium castings. It is self-contained and designed to make substantial savings in time and labor in all kinds of timber cutting. Features in addition to light weight include a positive fuel injection system and a newly designed chain and guide bar.—*Reed-Prentice Corp., Worcester, Mass.*



Fire Fighter—A fire extinguishing unit designed to furnish effective fire protection for outdoor industrial fire hazards has a capacity of 750 lb. of low pressure liquid carbon dioxide and 32 gal. of mechanical foam solution. Its two specially engineered, long range carbon dioxide nozzles, each with 100 ft. of ⅞ in. hose, have a combined discharge rate of 400 lb. of carbon dioxide per minute. A foam gun, on a 100-ft. ⅝ in. hose line has a discharge rate of 18 gpm. The unit is a compact four wheel trailer, using standard automobile wheels and front axle assembly and 6:00 x 16 tires, with a wheelbase of 52 in., and an overall height of 5 ft. 4 in.—*Cardox Corp., Bell Bldg., Chicago, Ill.*

Correction—On p. 118 of the Sept. 19 issue of *Engineering News-Record* there is a description of a seismograph reportedly manufactured by the *Diamond Instrument Co. Wakefield, Mass.* The Linehan-Arringdale seismograph, an instrument for recording earthquakes and related phenomena, designed for use in colleges and by professional seismologists, is manufactured by this company, but *not* an instrument for locating rock levels or for seismic prospecting.

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Wolverine Tractor & Equipment Co.
MINN...Minneapolis & Duluth—Reehot Equipment Co.
MISS...Jackson—Mississippi Road Supply Co.
MO.....St. Louis—Missouri-Illinois Tractor & Equip. Co.
Kansas City—Noel V. Weed, Inc.
MONT..Billings & Missoula—Industrial Equipment Co.
Great Falls—Hi-Line Equipment Co.
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North Platte—Cornhusker Tractor & Equip. Co.
NEV....Reno—Brown Motors
N. H...Manchester—R. C. Hazelton Co.
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N. M...Albuquerque—Hardin & Coggins
N. Y....Buffalo—Dow & Company, Inc.
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Cambridge—Major Equipment Co.
Marion—Hamilton Equipment Co.
OKLA..Tulsa & Guthrie—C. L. Boyd Company, Inc.
ORE....Portland & Eugene—Howard-Cooper Corporation
PA.....East Butler—Walsh Equipment Co.
Pittsburgh—Atlas Equipment Corp.
Philadelphia—Service Supply Corp.
Harrisburg & Wilkes-Barre (Kingston)—
State Equipment Co.
R. I....Providence—Tractors, Inc.
S. C....Columbia—N. H. Summers Road Machinery Co.
S. D....Sioux Falls, Rapid City—Empire Equipment Company
TENN..Knoxville & Chattanooga—Power Equip. Co.
Nashville—Industrial Tractor & Equipment Co., Inc.
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TEXAS..Dallas & Houston—Browning-Ferris Machinery Co.
San Antonio—Jess McNeel Machinery Co.
Plainview & Sweetwater—Plains Mach. Co.
El Paso—Hardin and Coggins
UTAH..Salt Lake City—The Lang Company
VA.....Richmond—Municipal Sales Company
Richmond and Roanoke—Rish Equipment Co.
Alexandria—Phillips Mach. & Tractor Co.
WASH..Seattle—Howard-Cooper Corp.
Spokane—Intermountain Equip. Co.
W. VA..Charleston and Clarksburg—Rish Equipment Co.
WIS.....Milwaukee, Eau Claire & Green Bay—Bark River Culvert & Equipment Co.

SEE Adams AD ON OPPOSITE PAGE

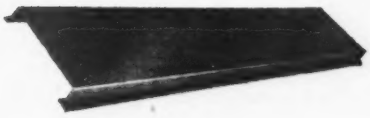
...L BASE ...ED

Fabricated from tight coat galvanized steel. Used principally for separating two plaster materials such as plaster walls from cement, terrazzo, or composition ..., and separating a cement wainscot ...dinary plaster. Another function is to ...permanent straight edge to which ...ades work.

METAL CASINGS

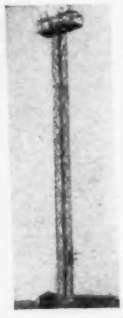
Meet a definite demand for an artistic, sanitary method of trimming around doors and windows. Afford many architectural effects. Metal casings are fire-resistant, vermin proof, easy to maintain and do not shrink or warp.

FERROBORD STEELDECK ROOFS



Truscon Ferrobord provides a fire-resistant, economical roof deck for all new construction or replacements. Covered with insulation and waterproofing, it weighs approximately 5 pounds per square foot.

...LOODLIGHT ...TOWERS

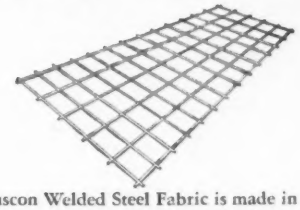


...e in a wide selection of ...ts, they offer a firm, ...g-lasting floodlight ...r for lighting in stadi..., parking areas, etc.

CURB BARS

Protect exposed corners of concrete curbs, walls, steps, etc. Designed to give positive anchorage into the concrete. Plate surrounds and protects the corner without splitting concrete into two portions.

WELDED STEEL FABRIC



Truscon Welded Steel Fabric is made in various sizes for concrete reinforcing in all types of structures. Each joint is electrically welded for permanence.

CONCRETE REINFORCING BARS

...A special rolled section of high grade steel, ...with a series of longitudinal and diagonal ...ribs, so designed to provide the maximum ...bond with the enclosing concrete.

PRESSED STEEL INSERTS

Truscon Slotted Inserts are attached to the forms and are completely imbedded in the concrete. Bolt can be moved along slot to any location, allowing wide variation in position. Used in ceilings, slabs, beams or columns.

OPEN TRUSS STEEL JOISTS

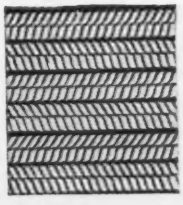
Truscon developed the open truss steel joists to meet the demand for economical, light weight, fire-resistant floors in schools, and other light-occupancy buildings. They are easy to install. Completely shop fabricated, they reach the job ready for placing.

CLERESPAN JOISTS

Truscon "Clerespan" Joists meet all clear span requirements up to 64 feet. They eliminate undesirable columns and provide greater unobstructed floor areas, in gymnasiums and auditoriums.

METAL LATH

There is a Truscon Metal Lath for every plastering requirement. Flat laths for ceilings and sidewalls; rib laths to reinforce concrete floors or plaster ceilings; expanded laths for stucco reinforcement; Corner Beads and Cornerite, to protect outside and inside corners.



CORNER BEADS

Recommended as an exposed corner reinforcement. The round nose is strongly reinforced by a deep groove which holds the plaster flush for a perfect bond. It can be wired, stapled or nailed to any kind of wall construction without the use of clips.

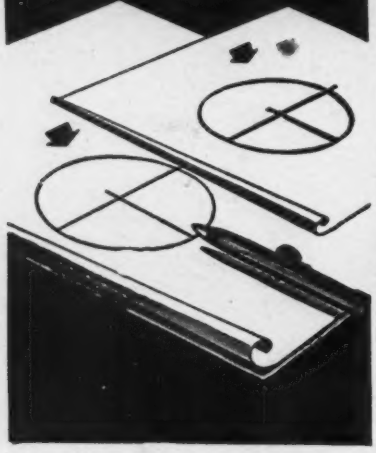
...USCON STEEL COMPANY

Reg. U.S. Pat. Off.

...STOWN 1, OHIO • Subsidiary of Republic Steel Corporation

Manufacturers of a Complete Line of Steel Windows and Mechanical Operators... Steel Joists... Metal Lath ... Steeldeck Roofs... Reinforcing Steel... Industrial and Hangar Steel Doors... Bank Vault Reinforcing ... Radio Towers... Bridge Floors.

Tracing cloth that defies time



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If you like a duller surface, for clear, hard pencil lines, try Imperial Pencil Tracing Cloth. It is good for ink as well.

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Power-Driven Chain Saw—A new gasoline engine-driven chain saw has 20-in. cutting capacity for one-man operation; 24- and 30-in. cutting capacities for two-man operation. Parts in all sizes are interchangeable.

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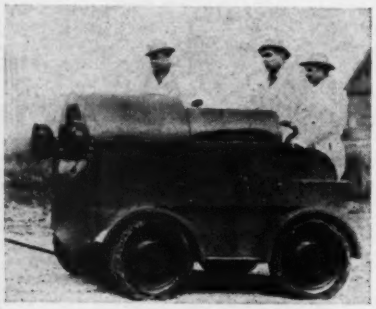

Fire unit protec hazar press gal. two carbo ft. of charg per 5/8 in 18 g whee whee x 16 and *Card*

Cor 19 i there repo *mon* The an in and use molo comp catin pecti

Adams DISTRIBUTORS
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ARIZ...Phoenix—O. S. Stapley Company
ARK....Little Rock—Little Rock Road Machinery Co.
CALIF...Western Factory Branch
J. D. ADAMS MANUFACTURING CO.
230 7th Street, San Francisco 3
Adams Distributors at: San Francisco, Los Angeles, Sacramento, Redding, Riverside, San Jose, Fresno, Stockton, Salinas, Santa Rosa, Modesto, Visalia, Merced, Bakersfield, Santa Maria and San Diego
COLO...Denver—McKelvy Machinery Company
CONN...New Haven—W. I. Clark Company
DEL....Phillips Machinery & Tractor Co., Baltimore
FLA.....Jacksonville, Miami, Tampa—Florida Equipment Co.
Pensacola—Ray-Brooks Truck & Tractor Company
GA.....Atlanta—Tri-State, Inc.
Albany—Tri-State Tractor Company
IDA.....Boise & Pocatello—Intermountain Equipment Co.
ILL.....Peoria & Springfield—A. E. Hudson Company
Salem, Carmi—E. W. Werner Equipment Company
Chicago—R. C. Larkin Co.
IND.....Indianapolis—Indiana Equipment Co., Inc.
IOWA...Des Moines—Herman M. Brown Company
KANS...Wichita—S. H. Denney Road Machinery Co.
KY.....Louisville—Brandeis Machinery & Supply Co.
LA.....Baton Rouge & Monroe—Dunham-Pugh Co.
MAINE..Portland—Maine Truck-Tractor Co.
MD.....Baltimore—Phillips Machinery & Tractor Co.
MASS...Newton Upper Falls—United Equip. Corp.
MICH...Bark River—Bark River Culvert & Equipment Co.
Detroit and Grand Rapids—
Wolverine Tractor & Equipment Co.
MINN...Minneapolis & Duluth—Reehot Equipment Co.
MISS...Jackson—Mississippi Road Supply Co.
MO.....St. Louis—Missouri-Illinois Tractor & Equip. Co.
Kansas City—Neal V. Wood, Inc.
MONT..Billings & Missoula—Industrial Equipment Co.
Great Falls—Hi-Line Equipment Co.
NEB....Omaha—Nebraska Tractor & Equipment Company
North Platte—Cornhusker Tractor & Equip. Co.
NEV....Reno—Brown Motors
N. H....Manchester—R. C. Hazelton Co.
N. J.....Trenton—Ross, Young, Dilts Company
N. M....Albuquerque—Hardin & Coggins

TIGH

BOU

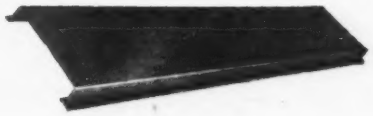
...AL BASE ...ED

Fabricated from tight coat galvanized steel. Used principally for separating two plaster materials such as plaster walls from ...cement, terrazzo, or composition ...e, and separating a cement wainscot ...dinary plaster. Another function is to ...permanent straight edge to which ...ades work.

METAL CASINGS

Meet a definite demand for an artistic, sanitary method of trimming around doors and windows. Afford many architectural effects. Metal casings are fire-resistant, vermin proof, easy to maintain and do not shrink or warp.

FERROBORD STEELDECK ROOFS



Truscon Ferrobord provides a fire-resistant, economical roof deck for all new construction or replacements. Covered with insulation and waterproofing, it weighs approximately 5 pounds per square foot.

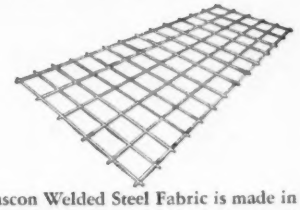
...LOODLIGHT TOWERS

...e in a wide selection of ...hts, they offer a firm, ...g-lasting floodlight ...r for lighting in stadi..., parking areas, etc.

CURB BARS

Protect exposed corners of concrete curbs, walls, steps, etc. Designed to give positive anchorage into the concrete. Plate surrounds and protects the corner without splitting concrete into two portions.

WELDED STEEL FABRIC



Truscon Welded Steel Fabric is made in various sizes for concrete reinforcing in all types of structures. Each joint is electrically welded for permanence.

CONCRETE ...REINFORCING BARS

PRESSED STEEL INSERTS

...ed to the ...ded in the ...ng slot to ...ariation in ...bs, beams

OPEN TRUSS STEEL JOISTS

Truscon developed the open truss steel joists to meet the demand for economical, light weight, fire-resistant floors in schools, and other light-occupancy buildings. They are easy to install. Completely shop fabricated, they reach the job ready for placing.

...H

...th for every ...aths for ceil... ...d sidewalls; ...s to reinforce ...ete floors or ...r ceilings; ex... ...ed laths for ...o reinforce... ; Corner Beads ... Cornerite, to ...ect outside and ...le corners.

CORNER BEADS

Recommended as an exposed corner reinforcement. The round nose is strongly reinforced by a deep groove which holds the plaster flush for a perfect bond. It can be wired, stapled or nailed to any kind of wall construction without the use of clips.

...HTLY

...UND

Manufacturers of a Complete Line of Steel Windows and Mechanical Operators... Steel Joists... Metal Lath ... Steeldeck Roofs... Reinforcing Steel... Industrial and Hangar Steel Doors... Bank Vault Reinforcing ... Radio Towers... Bridge Floors.

Whether You Make Fog Or It Comes Naturally...

Build with

WOLMANIZED LUMBER*

For built-in protection in artificially humidified buildings, or where industrial processes create steam and vapor, there's the place to use Wolmanized Lumber. This lumber, impregnated with Wolman Salts* preservative by pressure treatment, will give you many more years of service where rot-producing moisture is present.

Pressure Treatment

DRIVES PROTECTION DEEP

You can't just brush it on, you've got to drive it deep into the fibers of the wood to get real protection. At American Lumber & Treating Company, we do it under great pressure in steel retorts. You get positive protection.

*Registered trademarks

1649 McCORMICK BUILDING, CHICAGO 4, ILLINOIS

Manufacturers' Activities

THE PERMUTIT CO., manufacturer of water conditioning equipment, industrial ion exchangers and power plant specialties, has acquired the Simplex Valve and Meter Co. of Philadelphia, according to an announcement by H. W. Foulds, president. Mr. Foulds succeeds W. H. Roth as president of the newly-acquired subsidiary, while Mr. Roth becomes the Simplex board chairman. The Simplex Co., prominent in the design and manufacturing of equipment for the control and regulation of liquid flow, will continue to operate under its own name.

THE CALCIUM CHLORIDE ASSOCIATION has announced the moving of its offices from the Penobscot Bldg., Detroit, Mich. to the LaSalle Bldg., 1028 Connecticut Ave., N. W., Washington 60, D. C. The move has been under consideration for some time, and Washington selected because of facilities offered for engineering and technical reference in the fields in which calcium chloride is used.

STEWART CONSTRUCTION CO. of Oklahoma City have taken over the business of Gunite Cement Gun Construction Co. and will continue to do air-applied concrete construction in a large surrounding territory.

L. G. SCHRAUB, vice president and general manager, has been elected to the board of directors of Union Wire Rope Corp., 21st and Manchester, Kansas City, Mo.

Protected Steel Products Co. has recently changed its name to PLASTEEL PRODUCTS CO.

A. E. ANDERSON, recognized nationally as an authority on the engineering uses of explosives, has retired as manager of the Seattle division, E. I. duPont de Nemours & Co., after 39 years with the company.

THE AMERICAN KEENE CEMENT & PLASTER CO. plant at Sigurd, Utah, has been sold to the newly-formed Western Gypsum Co. for $1,500,000, K. J. Hill, president of the Salt Lake City branch of American Keene, reports. Sidney H. Eliason, Pacific Coast district manager of the U. S. Gypsum Co., and W. S. Mole, Chicago, are buyers of the plant and operations. The new company ex-

HOT OIL FAST!
..with Less FUEL..WATER..WORK

Handle that road oiling contract more profitably with a Cleaver-Brooks Tank Car Heater

The quicker you get the oil or asphalt in the tank car on the siding up to application temperature and flowing into the distributors—the faster your road crews can get going and finish the job.

With a Cleaver-Brooks Tank Car Heater you can have hot, dry steam flowing to car coils from a cold start in 20 minutes or less. And you can keep going all day with the least work and bother because a Cleaver-Brooks Tank Car Heater requires less fuel and water.

Perfected — highly efficient — you can tow it with car or truck to tank car siding, construction site, material yard or other locations where you need steam.

The famous Cleaver-Brooks four-pass fuel travel means low fuel consumption; the turbine type condensate return system cuts water loss — every drop of condensate goes back to the heater under pressure.

Built for full capacity — full time work — Cleaver-Brooks Tank Car Heaters will give you the most in production hours on the job. Write for bulletins and complete information.

CLEAVER-BROOKS COMPANY
5107 North 33rd St., Milwaukee 9, Wisconsin

Write On Your Business Letterhead . . . For the Bituminous — mix Calculator — a ready reference slide rule showing weight of mix needed in lbs. and tons in relation to width and depth of area to be covered.

Cleaver-Brooks

PIONEERS AND ORIGINATORS OF

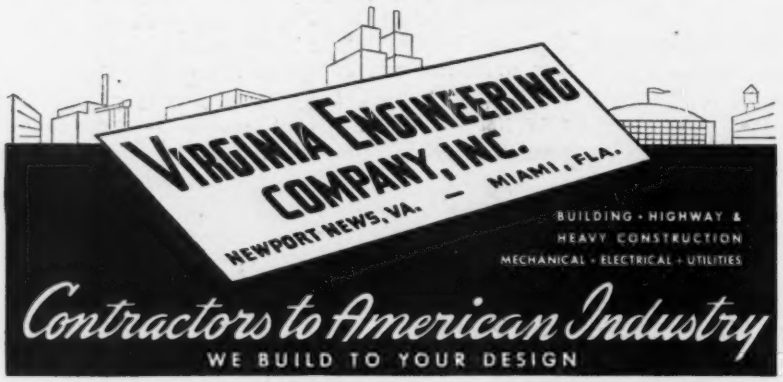
TANK CAR HEATERS . . . BITUMINOUS BOOSTERS . . . AUTOMATIC STEAM-PLANTS

Nothing Corny about Ceres

The Roman Goddess of Grain told men to dig deep and to plant carefully if they wanted to reap rich harvests. It's still good advice. Thirty-one years ago the *Virginia Engineering Company* planted its seeds deep in the American earth. From them sprang skill, versatility — know-how . . . a rich harvest of ability and accomplishment. . . . When you are ready to sow your building plans, let us help you plant them carefully—to insure for you a completed project that will yield you a rich, full harvest . . . in lasting satisfaction and pride.

CHALLENGE IN A STAMP

May we tell you the entire story of Virginia Engineering Company? We've executed more than a thousand complex contracts—*with never a single default!* Write us today.


VIRGINIA ENGINEERING COMPANY, INC.
NEWPORT NEWS, VA. — MIAMI, FLA.
BUILDING · HIGHWAY & HEAVY CONSTRUCTION
MECHANICAL · ELECTRICAL · UTILITIES
Contractors to American Industry
WE BUILD TO YOUR DESIGN

pects to produce gypsum lath and wall board, starting production next spring.

ROBERT D. EVANS has joined the sales development division of Caterpillar Tractor Co. as civil engineer consultant on earthmoving equipment and its applications. Mr. Evans completed pre-law studies at the University of Wisconsin, then obtained a degree in civil engineering from the University of Illinois.

HAROLD W. DAVIS is retiring after 36½ years' service with the American Hoist & Derrick Co., at the New York Office where he represented the company as branch manager. Raymond J. Dervey of St. Paul has been appointed manager of the company's Pittsburgh office. Ralph Thomson is leaving the Pittsburgh office to take over Mr. Davis' position as manager in New York.

CAPITOL STEEL CORP. of New York has removed its executive offices to 15 Park Row, New York 7, N. Y.

R. G. LETOURNEAU, INC., Peoria, Ill., has announced the following personnel changes in its general sales division: Wendell Richards, district sales representative in Pittsburgh, Philadelphia and Baltimore, has been promoted to the post of market research manager. Cloyd Richards, assistant service manager, has been named general service manager to succeed C. F. Zimmerman, who recently transferred to the sales field. O. A. "Jack" Williams has been appointed eastern sales manager to succeed Harry Conn, resigned. Replacing Mr. Williams is C. F. Zimmerman, former general service manager. Harold R. McQuarrie, eastern credit manager, has been appointed to the new post of assistant to the domestic sales manager; his duties will include serving as departmental coordinator.

BYRON JACKSON CO. has acquired the Butte Pump & Motor Works in Chico, Calif., which was established in 1925 as The Gas & Electric Service Co., the name was changed to Butte Pump & Motor Works in 1934. The business acts as a dealer for Byron Jackson pumps, and deals in the rewinding of motors, electrical wiring, servicing of neon signs and sale of appliances. A. F. Vonnegut will assume charge as manager, with no other changes in personnel.

Among the new executive appointments announced by Gen. Brehon Somervell, president of KOPPERS COMPANY, INC., are those of J. N. Forker as general manager of the new tar products division, and Dan M. Rugg as general manager of the new chemical division, both with offices in Pittsburgh. Other appointments include W. Reed Morris

At last

Small SCRAPERS for light earthmoving!

Just the thing for ditching and shoulder work . . . repairing slides and washouts . . . filling in around culverts and bridge abutments.

***A Practical Tool** for all light excavation, stripping, grading and hauling. Thrifty to buy . . . easy to operate . . . simple to maintain.*

Now Dozens of Small Jobs Can Be Handled Faster, Cheaper, Better Than Ever Before

Up until now, small earthmoving jobs have always been a problem because there has been no equipment available to handle them efficiently. Today, however, LaPlant-Choate offers you a dependable line of small scrapers especially designed for light earthmoving and already job-proved by extensive wartime use.

Whether you select the thrifty 2-yard design with gravity dump, or the larger 4-yard model with positive forced ejection and controlled spreading, remember both are easily adapted for use with crawler-type or high-speed, rubber-tired industrial tractors. Both are equipped with LPC's improved, single-unit hydraulic system for faster, more dependable operation. Both are skillfully engineered and ruggedly built to move earth at lowest possible cost per yard within their respective job ranges. For better results and bigger profits tomorrow, get complete facts today on these two great new LPC "Carrimors". Just address: LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa; 1022 77th Ave., Oakland, Calif.

ESTIMATED YARDAGE TABLE

● Here's a reasonable estimate of the number of yards moved per hour by LaPlant-Choate C-22 and C-42 scrapers behind high speed rubber-tired tractors of 22-28 DHP and 40-50 DHP respectively. Yardage is based on self-loading in good scraper material, with properly maintained haul roads.

Model	LENGTH OF HAUL IN FEET								Load, Turn and Dump Time	Pay Yards Per Trip
	200	300	400	500	600	800	1000	2000		
C-22	38	32	29	26	24	22	21	17	1.5 Min.	1.75
C-42	69	59	55	52	50	46	44	32	1.75 Min.	3.75

LaPLANT-CHOATE

Job-Proved Equipment... for Lowest Possible Cost in Moving Earth

Both are tough... but ONE is tougher!

TWO MOUNTAIN GOATS, bent on out-bucking each other, may be equally determined, but they're not equally strong. It's extra stamina, not determination, that wins the fight on the mountain crag.

TWO WIRE ROPES may both look like winners, but one will have the extra stamina that makes the critical difference in on-the-job performance.

ROCHESTER WIRE ROPES are extra strong because of our strong emphasis on the "4 M's" of wire rope fabrication—(men, methods, materials, machinery.) The MEN who make Rochester wire ropes are skilled in the application of the best known METHODS... work with MATERIALS of certified high quality... on the most modern MACHINERY available to the wire rope industry. For quick delivery of extra strong wire rope in any size, type, grade or construction—preformed or standard—call Rochester Ropes.

LOCKED-IN LUBRICATION is forced by air pressure between individual wires. This process requires twice as much lubricant as is absorbed by other methods ... protects against internal friction caused by rope passing over sheaves ... assures longer life and better service from wire ropes made by Rochester.

ROCHESTER *Ropes*

CULPEPER, VIRGINIA

Branch Offices & Warehouses: *Birmingham, Houston, Jamaica, N. Y., San Francisco*

as general manager of the new gas and coke division, Kearny, N. J., J. F. Byrne on special assignment for the engineering and construction division, and M. T. Herreid as manager of Koppers plants at Granite City, Ill., and St. Paul, Minn. George M. Walker is made manager of the new control section, attached to the president's office and J. C. Macon, Jr., is made general sales manager of the tar sales department. T. C. Keeling is sales manager of the new chemical division.

RAYMOND G. BECKLEY, of the sales staff of the Insulux Products division of Owens-Illinois Glass Co., Toledo, has been named district manager of the Pacific Coast, with offices in Los Angeles.

The Board of Directors of JOHNS-MANVILLE CORPORATION has elected Lewis H. Brown, president since 1929, to be chairman of the board and chief executive officer of the company. R. W. Lea, was elected president; Alvin Brown president for finance and a member of the Board of Directors and John P. Syme vice president and assistant to the chairman of the board.

C. M. TAYLOR has been elected executive vice president of The Lincoln Electric Co. by the board of directors. Mr. Taylor has been with the company since 1916.

THE ASH GROVE LIME & PORTLAND CEMENT CO., Kansas City, Mo., has announced several executive changes: L. T. Sunderland, formerly president, becomes chairman of the executive committee; W. P. Sabin, vice chairman of the executive committee; Paul Sunderland, chairman of the board; Allan B. Sunderland, president and secretary; L. Kittle, executive vice president and treasurer.

Appointment of LEONARD W. BECK as acting general sales manager of the Cummins Engine Co., Inc. has been announced by R. E. Huthsteiner, vice president assistant general manager and controller. Mr. Beck's new responsibility will be the overall administration of the distribution division (sales and service). His offices will be at the factory in Columbus, Ind.

THE KOMLINE-SANDERSON ENGINEERING CORP., Ridgewood, N. J., has been formed for developing and marketing machinery and equipment for the treatment of sewage and industrial wastes. Partners in the concern are Thomas R. Komline and Walter H. Sanderson. Arrangements have been made with the Instant Drying Corp. for use of the basic patent on the spray-drying of sewage sludge.

Manufacturers' Publications

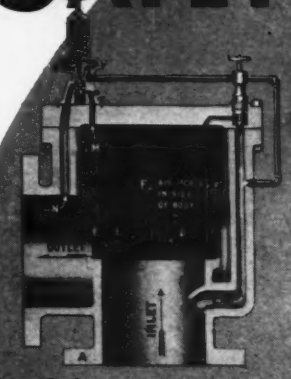
New Equipment Standards — The 1946 edition of Equipment Standards, just released, has been substantially revised and expanded. It details 30 standards covering "Freon-12" and ammonia compressors, condensing units, condensers, receivers, water and brine coolers, and self-contained air conditioning units, as well as 6 miscellaneous standards. Over 100 pages of material are broken down into five major divisions, with 26 illustrative figures and 16 pages of tabular material. Price $2. —*Air Conditioning & Refrigerating Machinery Association, Inc., Southern Building, Washington 5, D. C.*

Reduction of Evaporation Losses —A new 20-p booklet, "The Vaporsphere", describes the method of reducing evaporation losses from flat-bottom tanks storing volatile liquids by installing a vapor-saving system with facilities for the temporary storage of vapor. The method for determining the correct size of the Vaporsphere, used for temporary storage of vapor, is discussed, together with method of designing the vapor lines which connect the flat-bottom tanks to the Vaporsphere. The vapor pressure, expansion of air-vapor mixture and the flow of vapor in the lines can be read directly from charts included in the booklet. — *Chicago Bridge & Iron Co., 332 South Michigan Ave., Chicago 4, Ill.*

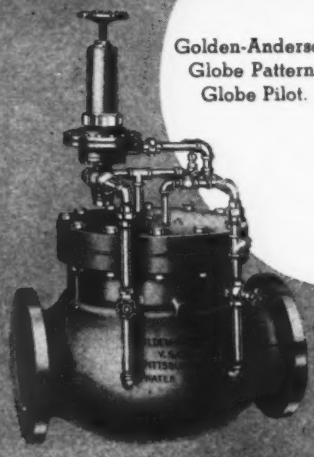
Power Plant Operation — "Steam Sales Improve Operation of Municipal Power Plant" is the title of a booklet that gives the case history of the Piqua Municipal Power system at Piqua, Ohio. The book outlines the advantages to a utility of selling steam in addition to electricity, and also the advantages to customers, namely, bringing power costs and manpower savings, and greatly reducing smoke nuisance. The book is illustrated with photographs and blueprints, and contains cost figures and other technical data. The story of the installation of underground steam conduit to serve steam customers is told in detail with many actual installation photographs.—*The Ric-wiL Co., Cleveland, Ohio.*

Water Supply and Booster Systems for Buildings—New 16-p. catalog (Bulletin 1500) with complete data on determining head and capacity requirements, selecting the proper system and

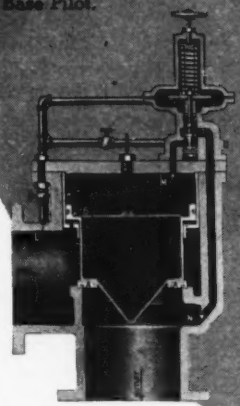
Engineered
SAFETY FACTORS



Golden-Anderson Angle Pattern, Base Pilot.



Golden-Anderson Globe Pattern, Globe Pilot.



Golden-Anderson Angle Pattern.

GOLDEN-ANDERSON
AUTOMATIC
WATER PRESSURE RELIEF VALVES

For absolute safety, specify Golden-Anderson Valves. On excess pressure, due to line surges or excess pumping head, these valves automatically open to dissipate necessary water volume to maintain desired line pressure. The valves are arranged either with atmospheric pilot valve exhaust or self-contained according to the service conditions and requirements. They may be arranged to open at abnormal pressures, and held open under subnormal pressures until the surge subsides, and then close when normal conditions again prevail. Available in standard sizes from 3 inch to 36 inch and working pressures from 150 pounds to 400 pounds.

GA

Contact Golden-Anderson for *advanced* valve engineering.

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VALVE Specialty Company
KEENAN BUILDING PITTSBURGH 22, PA

When you buy a new truck, you specify the make after carefully weighing all factors . . . every road and load condition . . . that affects your particular operation. But for the most profitable performance, don't neglect to specify the transmission, too!
There is a "proved in service" Fuller Transmission for every heavy-duty job . . . designed to operate quietly and dependably . . . and built to stand up under the most grueling conditions, on or off the highway.

FULLER MANUFACTURING CO., TRANSMISSION DIVISION
KALAMAZOO 13F, MICHIGAN
Unit Drop Forge Division, Milwaukee 1, Wisconsin

Fuller TRANSMISSIONS

pumping equipment, typical piping and pump installations, and approximate dimensions for layout purposes.—*Yeomans Brothers Co., 1439 N. Dayton St., Chicago 22, Ill.*

Underground Cable—A 12-p. booklet, "Simplex Anhydrex Underground Cable", gives stock lists, numerous tables, and directions for making splices. Illustrated.—*Simplex Wire & Cable Co., 79 Sidney St., Cambridge 39, Mass.*

Protective Coating Comparison Chart—A comprehensive 8-page technical bulletin, streamlined for ready reference, gives complete factual information in condensed form about the entire Amercoat line. Chart shows all characteristics and properties of Amercoat plastic coatings. Also, it is a ready guide for selecting the proper coating, preparation of the surface, and application methods on steel, concrete and wood. In addition, cost per square foot for materials, with area formulae, is provided.—*Amercoat Division, American Pipe & Construction Co., P. O. Box 3428, Terminal Annex, Los Angeles 54, Calif.*

New Design Manual—The third book in the series of technical treatises on ball bearings for designers and engineers has just been issued. Published under the generic title of *Engineering Service*, Part III covers enclosure and lubrication for all operating conditions.—*New Departure, Division of General Motors Corp., Bristol, Conn.*

Process Controllers — "Instruments and Controls for Process Industries," Bulletin, No. 17, describes and illustrates process controllers, control components, measuring components and instrument combinations. Application data such as sizes, pressure standards and ranges are listed for the various components. Typical control systems of both the single and multiple element type are illustrated.—*Bailey Meter Co., 1050 Ivanhoe Road, Cleveland 10, Ohio.*

Tachometers—Bulletin, No. S1400 describes line of tachometers recorders and indicators. The 12-p. bulletin includes complete descriptions of the Pyromaster potentiometer-type tachometer of the millivoltmeter-type indicating, and strip-chart recording tachometers. Complete wiring diagrams, application data, and accessory information are given, including illustrations of instruments, magnetos, and a typical installation.—*The Bristol Co., Waterbury 91, Conn.*

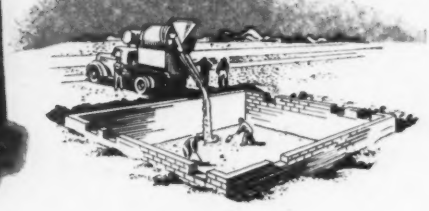
As part in its program to help solve the heat insulation problems of industry, the *Magnesia Insulation Manufac-*

WHEREVER CONCRETE IS USED ABOVE OR BELOW GRADE

TRUSCON Zilicon

WATERPROOFING PASTE PROVIDES AN *EXTRA* FACTOR OF SAFETY!

27 YEARS AGO . . . .
All foundations in the General Motors Building, Detroit, were waterproofed with TRUSCON ZILICON.
Albert Kahn, Inc., Architects & Engineers
Thompson-Starrett Co., Contractors



★ **Portland cement requires combination with water for mixing, chemical hardening and setting.**

★ **Only about TWO-FIFTHS of the water used combines CHEMICALLY and PERMANENTLY with the cement.**

★ **The OTHER THREE-FIFTHS is necessary only to give the mix WORKABILITY. Otherwise it is EXCESS.**

★ **This EXCESS is about 18.5 GALLONS—2.2 CUBIC FEET—8% of the average cubic yard of concrete.**

★ **This excess is present THROUGHOUT THE CONCRETE in millions of minute, incompressible droplets. In time, these evaporate, leaving millions of POSITIVE CAPILLARIES.**

★ **Thus, there is no such thing as "100% DENSITY" in concrete. PORES WILL ALWAYS BE PRESENT due to evaporation of excess water.**

★ **Pores are NATURAL POSITIVE CAPILLARY DUCTS. They eagerly DRINK UP MOISTURE from the earth or air.**

★ **Pores CAN'T BE PLUGGED but they CAN be made WATER REPELLENT by inducing NEGATIVE CAPILLARITY.**

★ **Truscon Zilicon Waterproofing CHANGES POSITIVE PORE CAPILLARITY TO NEGATIVE. Water is naturally repelled. You get an Extra Factor of Safety.**

Zilicon makes concrete more "workable" in mixing and chuting, reduces "honeycombing," increases particle attraction. Truscon has never tried to out-expert the experts. We believe concrete engineers and building designers know their business. Truscon Zilicon Waterproofing Paste merely does the job of reversing positive capillarity to negative, does it effectively —insures your concrete standing pat against moisture in the ground and in the air. That's our field of specialization—waterproofing—and for over 35 years we have an unbroken record of success in thousands of buildings, large and small. Write for complete descriptive Zilicon Folder. Dept. Z-1, *Truscon Laboratories, Division of Devoe & Raynolds Co., Inc., Detroit 11, Michigan.*

TRUSCON *Laboratories*

PRACTICAL is the Word for Ætna Contract Bond Service

As a contractor, you like to do business with practical men who are familiar with the operations and problems of your business. The experienced Ætna Contract Bond representative is such a practical man.

He conducts his preliminary investigation in a practical way — giving full credit for your professional skill and experience as well as your financial resources. He can be of real help to the contractor preparing for a period of expanding business. He can furnish a bond that is readily acceptable in any amount, on any private or public job, in any state of the Union. Moreover, he and his associated Ætna field representatives in all state capitals and major cities offer you many other practical services that save time and trouble, whether the job is in your home community or across a state line.

As a practical matter, contact your local Ætna man now . . . his organization can serve you in many ways.

Agents from Coast to Coast

ÆTNA CASUALTY AND SURETY COMPANY

AFFILIATED WITH ÆTNA LIFE INSURANCE COMPANY
AUTOMOBILE INSURANCE COMPANY STANDARD FIRE INSURANCE COMPANY
HARTFORD 15, CONNECTICUT

turers Association, composed of the manufacturers of 85 percent Magnesia heat insulations, has just released the first issue of its new publication, the M.I.M.A. News. Purpose of the new publication is to establish the News as a helpful medium of contact between the users and manufacturers.

Elliptical Screen — Bulletin 111-A, 12-p., describes Eliptex screen, which employs unique elliptical motion with three separate components, horizontal, vertical and elliptical. Specific applications for dewatering, heavy media dewatering and asphalt plants are defined. Dimensions and clearances in single, double and triple-deck types are given. —*Robins Conveyors, Inc., Passaic, N. J.*

Self-locking Nuts — "Test Procedure", 16-p. booklet, describes procedure for testing locking effectiveness of self-locking nuts and related fastening devices. Details are given on equipment and procedure for making tests for vibration, installation and removal torque, re-use torque, and wearing and plating with application to individual fastener problems—*Elastic Stop Nut Corporation of America, Union, N. J.*

Heavy-Duty Flooring — Hexteel, heavy-duty steel grid, scientifically designed to be imbedded in concrete, mastic or any plastic floor material, is described and illustrated in 6-p. folder. It comes in standard units, 3x10 ft., 12- and 14-gage thicknesses, and ¾-, 1- and 1¼-in. depths.—*Wm. F. Klemp Co., 6601 S. Melvina Ave., Chicago 38, Ill.*

Wire Rope Clamps — Safe-line clamps are described and illustrated. Results of tests are given.—*National Production Co., 4550 St. Jean Ave., Detroit 13, Mich.*

Portable Grinding Machines — Catalog MX 683, 8 pp., describes and illustrates new all-purpose portable grinding machines and tools for wet grinding, wet rubbing, wire brushing, drilling, sanding and smoothing.—*Master Vibrator Co., 200 Davis Ave., Dayton 1, Ohio.*

Aggregate Flooring — Bulletin No. 602 explains how 100 percent emery aggregate can be turned into dense, cohesive, nearly diamond-hard surface known as Emeri-Crete flooring by adding cement and water. Illustrations show how it has been successfully applied in many industries.—*Walter Maguire Co., Inc., 330 W. 42nd St., New York 18, N. Y.*

Low Capacity Tester — Use of the low-capacity Dillon universal material tester is simplified and its range of use

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extended by a set of factoring tables now available for translating small specimen results to full size of material. —*W. C. Dillon & Co., Inc.*, 5410 *W. Harrison St., Chicago* 44, *Ill.*

Suction and Fire Hose—Catalog sections on suction hose for sand and gravel service; on industrial fire hose for mill and plant protection; on carbon dioxide fire extinguisher; and on Flexseal hose joint provide pictures and data.—*B. F. Goodrich Co., Akron, Ohio.*

Land Leveling—Earthmoving economies are outlined in 4-p. folder which gives ten reasons for using Tournapulls on land leveling jobs. Pamphlet is illustrated with on-the-job photos accompanied by short job stories.—*R. G. LeTourneau, Inc., Peoria, Ill.*

Insulators—Descriptions of three new Vibro-Insulators, Types 130, 133 and 144, are included in 12-p. booklet. These devices of rubber and metal for use on office equipment and portable machinery are said to provide quieter operation, greater stability and vibration absorption. Booklet outlines proper selection of insulator for specific requirements, cites many typical applications and gives complete table of characteristics of each type.—*B. F. Goodrich Co., Akron, Ohio.*

Wire, Strip and Rod—Choosing wire, strip or rod of uniform dimensions for difficult high temperature or corrosive applications is made easier by engineering data and illustrations in 28-p. catalog.—*Alloy Metal Wire Co., Inc., Prospect Park, Pa.*

Portable Hydraulic Pipe Bender — (8-p. bulletin) Gives details of construction, capacity, features and maintenance. Chart of radii of bends to center line of pipe is included.—*Watson-Stillman Co., Roselle, N. J.*

Welding Aluminum — (88-p. book) Covers latest practices and recommendations for joining aluminum by gas, arc and resistance welding, brazing and soldering. It analyses recommended gas welding practice, and includes chapters on welding by metal-arc, carbon-arc, atomic-hydrogen and inert-gas-shielded processes.—*Reynolds Metal Co., Louisville, Ky.*

Rip and Sizing Saw — (4-p. two-color bulletin) Describes Model 50, designed for use either with Linderman automatic wood prefabricating machine or as general purpose saw for woodworking industry. Pictures and detailed specifications are included.—*Muskegon Machine Co., Inc., Newburgh, N. Y.*

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Elections and Activities

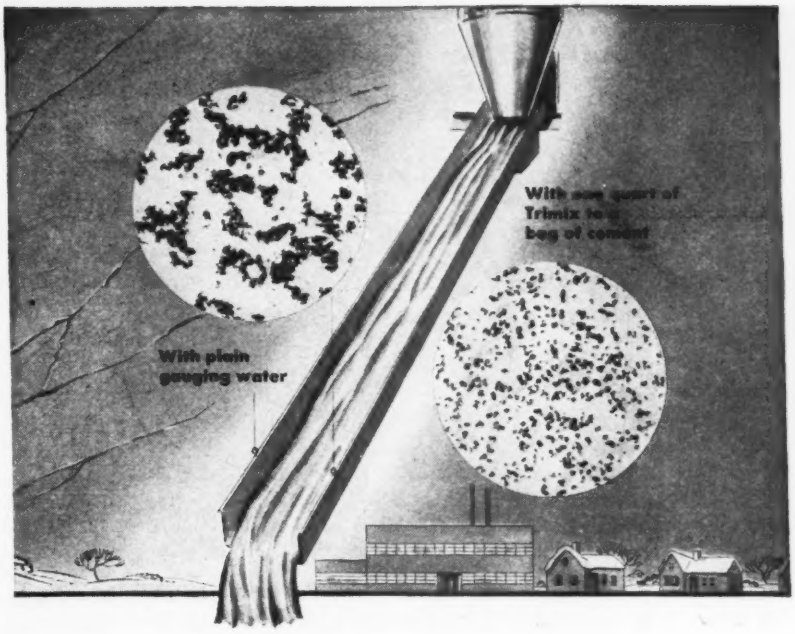
F. J. Campbell, Joliet, Ill., has been elected president of the American Railway Bridge and Building Association succeeding Neal D. Howard, Chicago. Other officers elected were: J. S. Hancock, Dearborn, Mich., first vice-president; E. H. Barnhart, Garrett, Ind., second vice-president; W. F. Barnett, San Bernardino, Calif., third vice-president; and W. A. Huckstet, St. Louis, fourth vice-president.

Officers of the Pacific Coast Building Officials conference have been elected as follows: President, James H. Park, Compton, Calif.; first vice-president, H. O. Rasmussen of Santa Ana, Calif; second vice-president, Frank H. Rogers, Medford, Ore.; and Hal Colling, Pasadena, Calif., manager-secretary.

Election of J. S. Hudnall of Tyler as chairman of the Texas State Board for Registration of Professional Engineers has been announced. Other newly-elected officers are: A. F. Mitchell of Corsicana, vice-chairman; and Carl L. Svensen of Lubbock, secretary. Other board members are J. B. Thomas of Fort Worth, E. W. Pittman of Beaumont,, and Datus E. Proper of San Antonio.

Mark R. Kulp, Idaho state engineer, has been elected president of the Association of Western States Engineers. O. C. Williams of Arizona was chosen vice-president. The organization has adopted resolutions asking that Army Engineers be required to comply with state laws regarding water rights; requesting Congress to grant funds for a U. S. Geological Survey to be matched by state funds; recommending that public law 534 be amended to include compliance by federal agencies with state laws relative to ownership, control and administration and use of waters; approving interstate water compacts as a means of solving water problems and requesting the President to have a complete mapping program instituted for the West.

The Washington State Good Roads Association has elected Harry Cotton, Port Townsend, president; Foster McGovern, Seattle, treasurer; Douglas A. Shelor, Seattle, executive vice-president and the following vice-presidents: C. B. Fitzgerald, Seattle; Charles F. Larrabee, Bellingham; Austin McCoy, Vancouver, Ernest Huntley, St. John;



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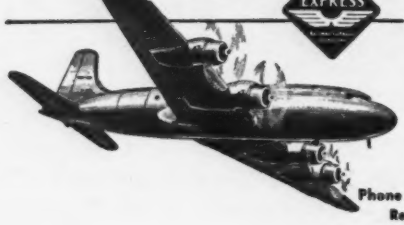

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J. R. Everett, Okanogan, and Lyle Abrahamson, Tacoma. Named to the executive committee were Frank Barrett, Clinton S. Harley and Olaf Caskin, Seattle; Henry Brown, Poulsbo; Ed. R. Brown, Suquamish; Grant Sission, Mount Vernon; M. J. Schmitt, Port Angeles; Perry Black, Everett; John C. Pierce, Bellingham; Tom Milroy, Port Townsend, Fred Mason, Vancouver; Wesley Vandercook, Longview; George W. Gauntless, Aberdeen; A. C. Kramer, Long Beach; H. J. Josefsky, Alympia; Henry Copeland, Walla Walla; Wendel Brown, Pasco; Conrad Hergert, Endicott; Harry Egbert, Easton; Herb Holmes, Ellensburg; L. D. Halloway, Winthrop; W. J. Gray, Wilbur; W. C. Raugust, Odessa; Louis G. Bovee, Cashmere, David Guilbert, Spokane; W. C. Raleigh, Burwell Bantz and Paul H. Sceva, all of Tacoma; William Hoyt and Lee Monohan, both of Renton.

Owen E. Clark, division engineer, Toledo water department, has been elected president of the Toledo chapter, Ohio Society of Professional Engineers. Other officers are: Raymond E. Hall, assistant Lucas County sanitary engineer; vice president; Vance J. Gray, of Geo. Lathrop & Sons, Inc., secretary-treasurer; J. A. Reece, Surface Combustion Corp., mechanical director; J. H. Toulouse, Owens-Illinois Glass Co., chemical director; and William T. Hallauer, structural engineer for Toledo Board of Education, structural director.

Russell W. Abbott, of the Libbey-Owens-Ford Glass Co., has been elected president of the Toledo, Ohio, Technical Council, composed of 18 technical societies in that city. Other officers are Roy T. Peterson, vice-president; and Walter M. Campbell, secretary-treasurer.

Construction League of Indianapolis, Ind., has appointed Marshall D. Abrams as managing director.

L. L. Schroeder, Minnesota aeronautics commissioner, was elected president of the National Association of State Aviation Officials at their recent meeting in Butte, Mont. His election parallels that of Mr. J. Hoffman, Minnesota, commissioner of highways who earlier this year was elected president of the American Association of State Highway Officials. Minnesotans thus head two nationally known groups in the public works construction field.

P. L. Patterson, of the Patterson Equipment Co., Cleveland, is president of the Ohio Equipment Distributors Assn., incorporated last August as a non-profit organization, comprising

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David B. Lee has been elected president of the Engineering Professions club at Jacksonville, Fla. Other officers elected to serve with him were Richard W. Cloues, vice president; C. F. Garland, secretary; S. O. Rousseau, treasurer, and Jack Shea, Program chairman.

A. S. G. Musgrave, municipal engineer of Oak Bay, B. C., has been named secretary-treasurer of the Public Works and Municipal Engineers Association for 1947.

Clearwater, Fla., contractors have formed the Clearwater General Contractors Association and have elected J. W. Barnes president. Other officers are George T. Clenny, vice-president; R. M. Thompson, Jr., secretary; George F. Gillespie, treasurer, and Ted Alshouse and Henry Lockett, directors.

Engineers of Macon, Ga., and of the Sixth District have just formed a Chapter. Officers will be installed Sept. 9. Joel Bealle was temporary chairman in the organization. Carl W. Evans, President of Georgia Society of Professional Engineers addressed the meeting on matters of current interest.

Ward Webber, The Dalles, Ore., was recently elected president of the Northwest Rivers and Harbors Congress. Maurice Andersen, Newport, Ore., and Roy Whitcomb, Willapa Harbor, Wash., were chosen vice-presidents; Henry Daview, Port Angeles, Wash., treasurer, and Alex Stewart, Seattle, secretary.

The North Carolina League of Municipalities has elected these officers: Henry T. Powell, mayor of Henderson, N. C., president; Earl H. Tate, mayor of Lenoir, N. C., 1st vice-president; R. M. Cooksey, city manager, Thomasville, 2nd vice-president and H. H. Baxter, mayor of Charlotte, N. C., 3rd vice-president.

Roy S. Braden of High Point has been elected president of the North Carolina City Managers Association. He succeeds Henry A. Yancey of Charlotte. The only other officer elected was G. C. Ferguson of Waynesville, named secretary.

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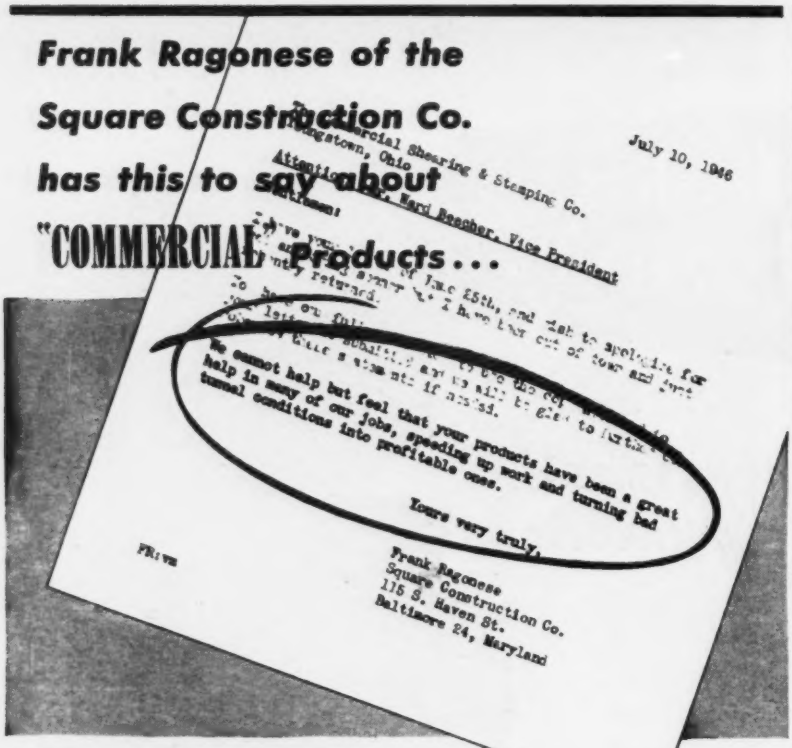
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Men and Jobs

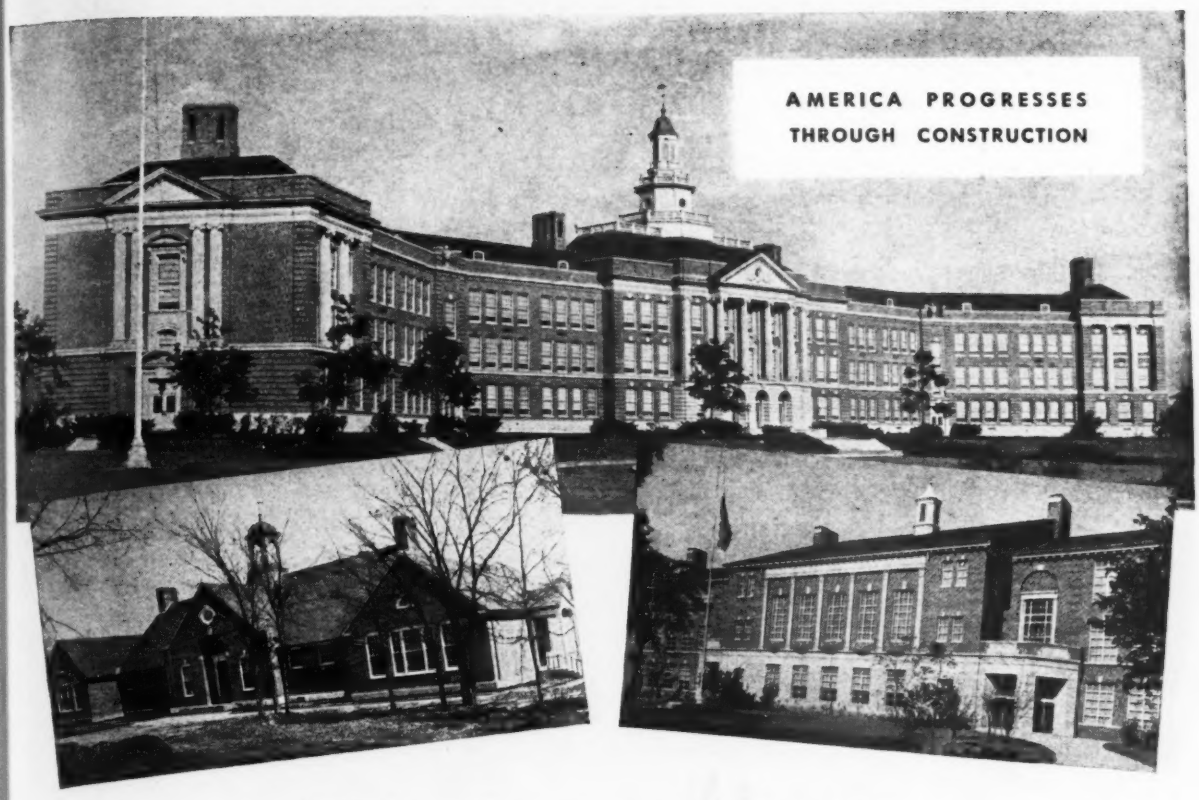
S. Kenneth Love became chief of the quality of water division of the United States Geological Survey at Washington, D. C. on Oct. 1. He succeeds W. D. Collins who had occupied the position for 26 years up to his retirement Sept. 30. Mr. Love received the degrees of B.S., 1927, and M.S., 1930, from the University of Florida at Gainesville. He began work as a chemist in the Geological Survey June 22, 1923, and has served continuously except for a short period of leave for graduate study in 1930. He has conducted and supervised field and laboratory studies in many parts of the United States on different phases of quality of water, including extensive studies relating to sediment in surface waters.

A. L. Hertz, formerly a lieutenant colonel, Corps of Engineers, in the Africa, Europe and Middle East, and Asiatic-Pacific Areas, has returned to his civilian position with the U. S. Engineers in the Mobile, Ala., district.

Lt. Col. Vernon A. Shurm of the U. S. Army Engineers recently was assigned as assistant engineer commissioner for the District of Columbia. Colonel Shurm, a graduate of Virginia Polytechnic Institute in 1933, has been appointed to the regular Army. From 1933 to 1940 he was employed by the Virginia Electrical Power Co. and in October, 1940, joined the Army and was assigned as post engineer at Fort Monroe. From 1943 to 1944 he served in the office of service command engineer at Baltimore and from 1944 to 1946 in the engineer section of the headquarters of the India-Burma theater. His duties from January, 1946, to May, 1946, were those of theater engineer in the India-Burma theater.

The new sanitary engineer of Marin County, Calif., is **Arnold Prucha.** Formerly employed by the health department at Winnetka, Ill., Prucha was selected from a large number of applications submitted for the newly-created post.

Four members of the Montana Highway Department will receive 25-year



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Over 39% of the cities of 10,000 population and over need additional school plants. The U. S. Office of Education is authority for the fact that approximately $18,000,000,000 in construction, at 1940 prices, is needed by the public schools of the United States to eliminate deficiencies in existing buildings and facilities and to provide needed additional buildings to meet increased enrollments.

More than half of our present school structures are over 30 years old. These old buildings are generally lacking in modern facilities for science, art, music, trades and vocations, recreation, assembly and adult use.

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Amsco Dippers Handle Record Volume of Sandstone and Shale

One of the nation's heaviest grading operations featured the construction of the Kanawha Airport at Charleston, West Virginia. This job involved the handling of 9,700,000 cubic yards of material. In the early stages, power shovels worked ledges which were 300 ft. or more above the lowest filling levels. The job averaged about 40% rock, consisting of three layers of sandstone, separated by shale beds.

The contracts held by Harrison Construction Co. for grading the runways posed a real test of skill and efficiency. Harrison's key policy was to use plenty of the most modern equipment, with which 1,800,000 cubic yards of material were moved between October, 1944, and June, 1945, despite a cold winter and wet spring.

A-513—2-yd. Amsco streamline welded type dipper bites into king sized chunks of sandstone on the Kanawha Airport job.

A-518—Lorain 82 shovel with 2-yd. Amsco all-manganese-steel renewable lip dipper, loading blasted sandstone and shale at Kanawha Airport.

Seven 1¾ to 2½-yd. power shovels worked at three or more ledge points on stone and shale. Shovels in this size range were chosen in preference to larger ones for greater flexibility in planning operations, easier transporting, and because they are easier on the handling equipment.

Handling blasted sandstone and shale in large volume imposed a heavy responsibility on the power shovel dippers, as continuous operation was important. Out time for dipper repairs and replacements would have been extremely costly on this job. Impact shocks and abrasive wear from the material handled would have meant rapid destruction for dippers of ordinary steel.

Logically, manganese steel dippers were employed. The pictures show some of the 2-yd. Amsco dippers on Lorain 82 shovels at work on the Kanawha Airport. Made of "the toughest steel known," these dippers stand up for maximum periods in even the most abusive service.

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merit awards from the American Association of State Highway Officials, according to Howard W. Holmes, state highway engineer. They are **P. G. Poore** of Helena, road location engineer and department employe for 25 years; **W. G. Keifner,** Helena, equipment engineer with a 26-year record; **Robert L. Ewing,** district engineer at Wolf Point, a veteran of 27 years, and **Myron C. Lockey,** district engineer at Kalispell, also with 27 years of service.

Arthur D. Krohne, former district sanitary engineer for the Wisconsin State Board of Health, has been appointed city engineer for Oconomowoc, Wis., to succeed J. Alex Stemper. He will be director of public works.

Jackson B. Hayden, town engineer of Montclair, N. J., on leave of absence to the armed forces since June, 1941, has resigned the Montclair post to become district airport engineer for the Civil Aeronautics Administration in Virginia. He will be succeeded by **Frederick M. Galloway,** who has been acting town engineer.

U. V. Engstrom has been transferred by the Bureau of Reclamation to the Enders Dam Unit of the Frenchman-Cambridge Project with headquarters at Imperial, Neb. He is assigned as construction engineer on the Enders Dam dike, and relocation of State Highway No. 61. He has been employed by the bureau since 1935, having worked on the Provo River project in Utah, the Denver design office, and the Boise project in Idaho. His last assignment was on the construction of Anderson Ranch Dam in Idaho as field engineer.

Robert G. Garland has succeeded Lee Puryear as Kentucky state highway engineer in the first district at Paducah. Mr. Puryear goes to Frankfort as an assistant in the central office's maintenance division.

Abner Gwinn, Jefferson City, Mo., engineer in the Missouri highway department since 1923, has been named chief of the state parks by the Missouri State Park Board, which plans a large construction program. Mr. Gwinn is a graduate of the college of engineering, University of Missouri. He participated as a civil engineer in the wartime expansion of Fort Leonard Wood, Mo.

H. A. Whittaker, director of the Division of Sanitation, Minnesota State Board of Health, has resigned to become professor of public health engineering at the University of Minnesota School of Public Health. Col. Herbert M. Bosch, who has just returned from

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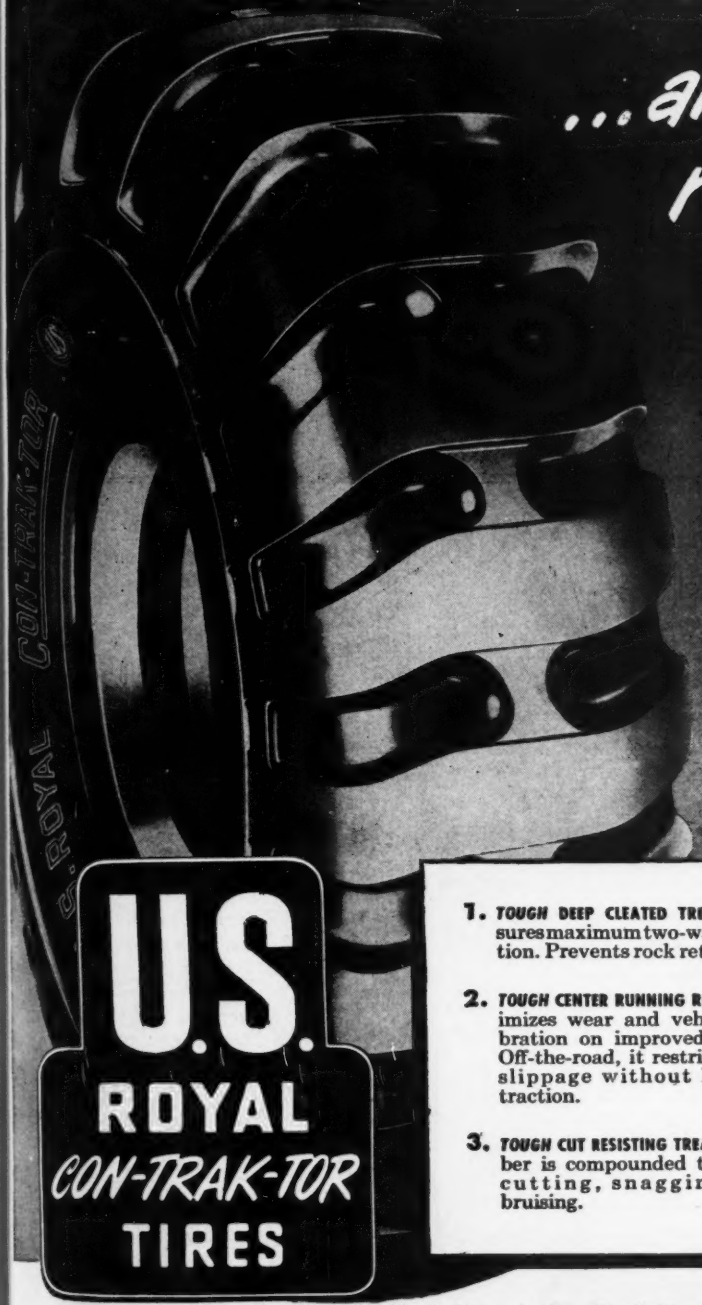

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Experienced fence engineers plan and help erect Continental Chain Link fence anywhere. Continental engineers will work out the most effective and economical installation for any property protection problem you may have. Write for free fence manual.

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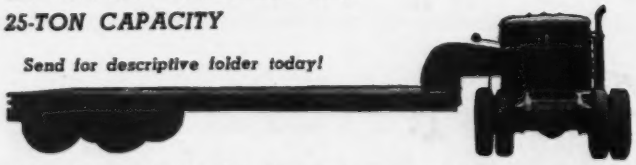

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military service, will succeed Mr. Whittaker, who has been the director of the sanitation division since it was organized in 1914.

Charles E. Ryder, for 25 years chief engineer of the Pennsylvania State Department of Forests and Waters, has been commissioned by Harrisburg and Dauphin County, Pa., officials to make an extensive study to determine what can be done to reduce flood hazards there.

Floyd T. Johnson is now chief of technical section, construction division, Omaha, Neb., district, U. S. Engineers. He had been associated with the Galveston, Tex., district as soils and paving engineer in technical charge of the wartime airfield program there. He began with the U. S. Engineers in 1930 at Rock Island, Ill. He took his B.S. degree at Augustana College, Rock Island, and graduate work at the University of Chicago and the University of Texas.

William Phillips is now acting Jefferson County superintendent of highways, Mt. Vernon, Ill., to fill the vacancy left by former Superintendent Ben J. Hunter.

Oral B. Dold has been promoted from acting to full DePage County superintendent of highways, Wheaton, Ill.

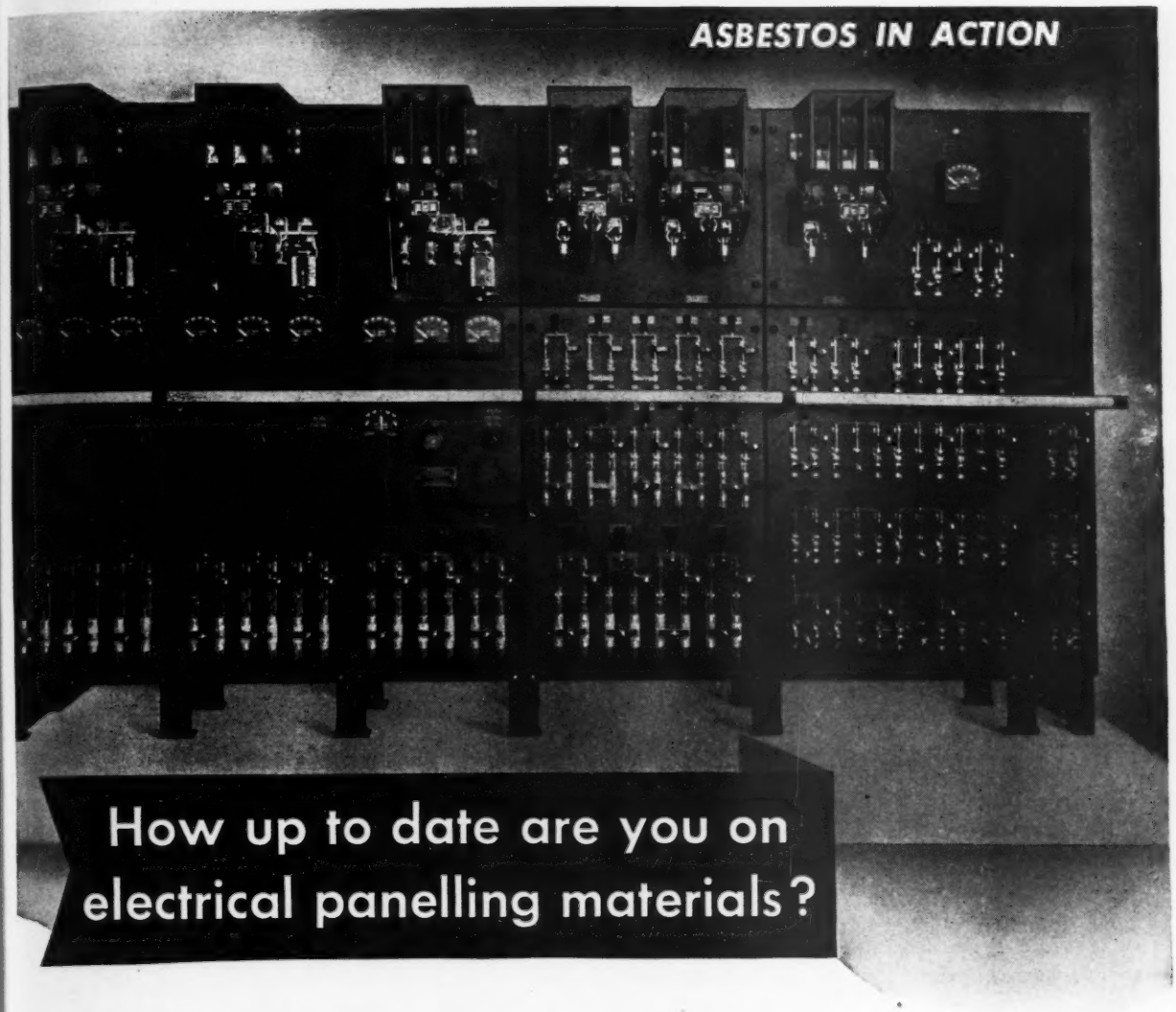
Lyle Avery Wilson, for many years an engineer in the bridge office, Illinois Division of Highways, Springfield, started Sept. 23 with Sverdrup and Parcel, St. Louis, Mo.

William John Mackay is acting as engineer of railroad crossings, Illinois Division of Highways, Springfield.

Walter William Colpitts, consulting engineer of New York City and a native of New Brunswick has been elected a member of the Board of Governors of McGill University, Montreal. Mr. Colpitts is a McGill graduate in engineering.

C. Y. Griffin, resident engineer at Jacksonville, N. C., for the North Carolina Highway Commission, has been transferred to New Bern, along with his party, consisting of **F. N. Poole, T. F. Harrington, J. L. Kilgo, William L. Mellville** and **Mark Outland.**

Roger G. Powell and Associates announce the organization of Designers—Engineers Inc., to engage in design, engineering, construction, financing, flood control, power and navigation projects, industrial plants, municipal



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What about the panels, switchboards, bus bar runs, and other electrical apparatus mountings in your plant? Are they proof against absorption of moisture and oil? Do they stand up under high voltage surges, vibrations, and temperature changes, retain a business-like appearance without costly maintenance?

You can answer "yes" to all those questions if your electrical apparatus is mounted on K&M Ebonized Asbestos, the *modern* panelling material. Fabricators who work it and plants that use it say Ebonized Asbestos is ideal for the purpose.

Made of tough asbestos fibres, cement and an insulating compound, K&M Ebonized is moulded into strong monolithic sheets with exceptionally high dielectric strength. It gives extra-long service, in fact it grows tougher with age. Meets the requirements of Underwriters' Laboratories, Inc., when built into an assembled unit. Write us for full technical data on this superior mounting material.

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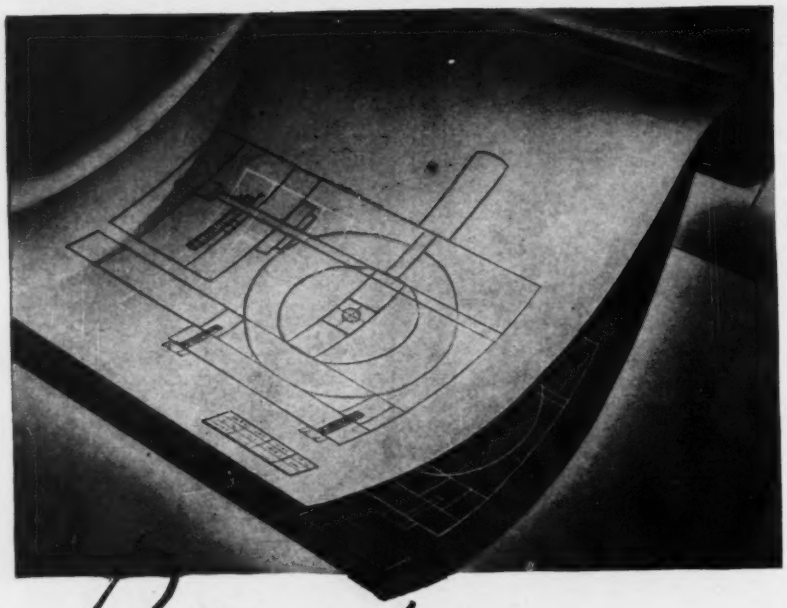

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works, hospitals and airports. Their address is 165 Broadway, New York 6, N. Y.

J. B. Jennette, Jr., of New Bern, N. C., for the last several years supervisor of the maintenance department of the second division of the North Carolina Highway Commission, has been transferred to the construction department as senior resident engineer.

D. B. Rees, recently retired as senior construction engineer with the Royal Canadian Air Force, and formerly district engineer in the department of Lands and Mines, Alberta, has been named manager of the Edmonton branch of the Central Mortgage and Housing Corp.—(a Crown Company).

Charles L. Harrison has been elected to the board of directors of W. L. Maxson Corp., engineers, of 460 West 34th Street, New York City. He is president of Victor Electric Products, Inc., of Cincinnati, which recently was acquired by Maxson's.

George B. Tuggle has been appointed office engineer of the Honolulu Gas Co. He will assist Plant Superintendent Harold Saueressig in his work with the company's new $1,000,000 development program. After being graduated from the U. S. Naval Academy in 1927, Tuggle served as an engineer in civil life. Reentering the Navy during the war, he served as officer-in-charge of an advanced base repair component at Mare Island, Calif., and in the advanced base section on the staff of the Commander, Service Force Pacific. He was discharged recently as a commander, reserve.

Gen. A. G. L. McNaughton, Canada's engineer-general and for years president of the National Research Council of Canada, has been appointed president of the Canadian Atomic Energy Control Board. The other members are George C. Bateman, a mining engineer, Dr. Paul E. Gagnon of Laval University, Quebec, and V. M. T. Scully, deputy minister of the federal Department of Reconstruction.

William Rehus is engineering and architectural representative of Hummel, Hummel and Jones, Boise, Ida., on the construction of the Terminal Hotel at Winnemucca, Nev. He had previously been engineer, design and construction division, for the U. S. Bureau of Reclamation at Denver, Colo.

Clarence R. Andrew, head civilian engineer of the Chicago district office of the U. S. Engineers, has been awarded the War Department's Exceptional

More Yards MOVED PER H.P.

because every Main Shaft rolls on Anti-Friction bearings

On the Koehring 205 engine horse power rides to work in style, on anti-friction bearings. All major shafts—drum shaft, counter shaft and swing shaft—are mounted on ball bearings. Because there's little friction to waste engine horse power, greater digging force gets to the business end. Power saved pays off in extra yardage. Lubricating time is reduced, because bearings are sealed tight to hold lubricant, to lock out dirt and moisture.

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stretches normal concreting schedules far into COLD WEATHER

Whenever the thermometer falls to 50° F. or below, concrete slows up—takes longer to attain strength required for removal of forms—delays placing succeeding courses—delays completion of the job.

Such delays are easily avoided and summer schedules maintained in cold weather by using calcium chloride in all concreting. While most engineers and contractors feel obliged to use calcium chloride in winter concrete, many fail to realize that it does the same work of speeding job schedules the year around, and supplies "built-in" curing as a bonus.

Get the facts from our technical booklet "Early Strength Concrete," yours on request.

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DIAMOND AND SHOT CORE BORINGS — DRY SAMPLE BORINGS

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Civilian Service Award for exemplary performance of duty during the war. He directed and coordinated all activities necessary to the passage of more than 1,000 war vessels through the Illinois Waterway from Lake Michigan to tidewater at New Orleans.

Recently discharged from the Marine Corps, **Laroyd Bullard** has returned to his former position as office engineer in the Kitsap County engineering department at Port Orchard, Wash.

A. H. Davison, formerly for 10 years head of the estimates section in the Providence, R. I., district of the U. S. Engineer Department, and during the war active in design and construction of military airfields, is now in private engineering practice at Glens Falls, N. Y.

Oscar Hettema, who was with the Civil Engineering Corps of the Navy during the war, has been appointed city manager of Dade City, Fla.

Robert L. Reisinger, Jr., a civil engineer who served for 16 months as assistant post engineer at North Field, Guam, with the rank of lieutenant, has joined his father in Robert L. Reisinger & Co., general contractors, Milwaukee, Wis.

George Jordan, of Greensboro, N. C., has been named veterans housing coordinator for that city. A graduate of N. C. State College in construction engineering for some time he was in charge of residential construction for Marshall Field & Co., at Spry, N. C. During the war he supervised the erection of emergency housing units at Berdeen, Goldsboro, New Bern, Edenton and Hertford, N. C. He will now direct the reconversion of former Army barracks for use by veterans.

H. S. Duebelbeiss, assistant engineer in the office of the chief engineer of the Canadian Pacific Railway at Montreal since 1912, has retired. He had a leading part in drawing plans for many important bridges in Canada.

T. J. Kauer, managing director, Wire Reinforcement Institute, Inc., has been named chairman of the subcommittee on structural features of concrete pavements of the American Road Builders' Association committee on rigid pavement design. A graduate civil engineer from Ohio State University in 1928, Mr. Kauer was employed as a highway engineer by the Ohio Department of Highways in Cleveland and Columbus from 1927 to 1940. Serving as an airport paving engineer with the Civil Aeronautics Administration in

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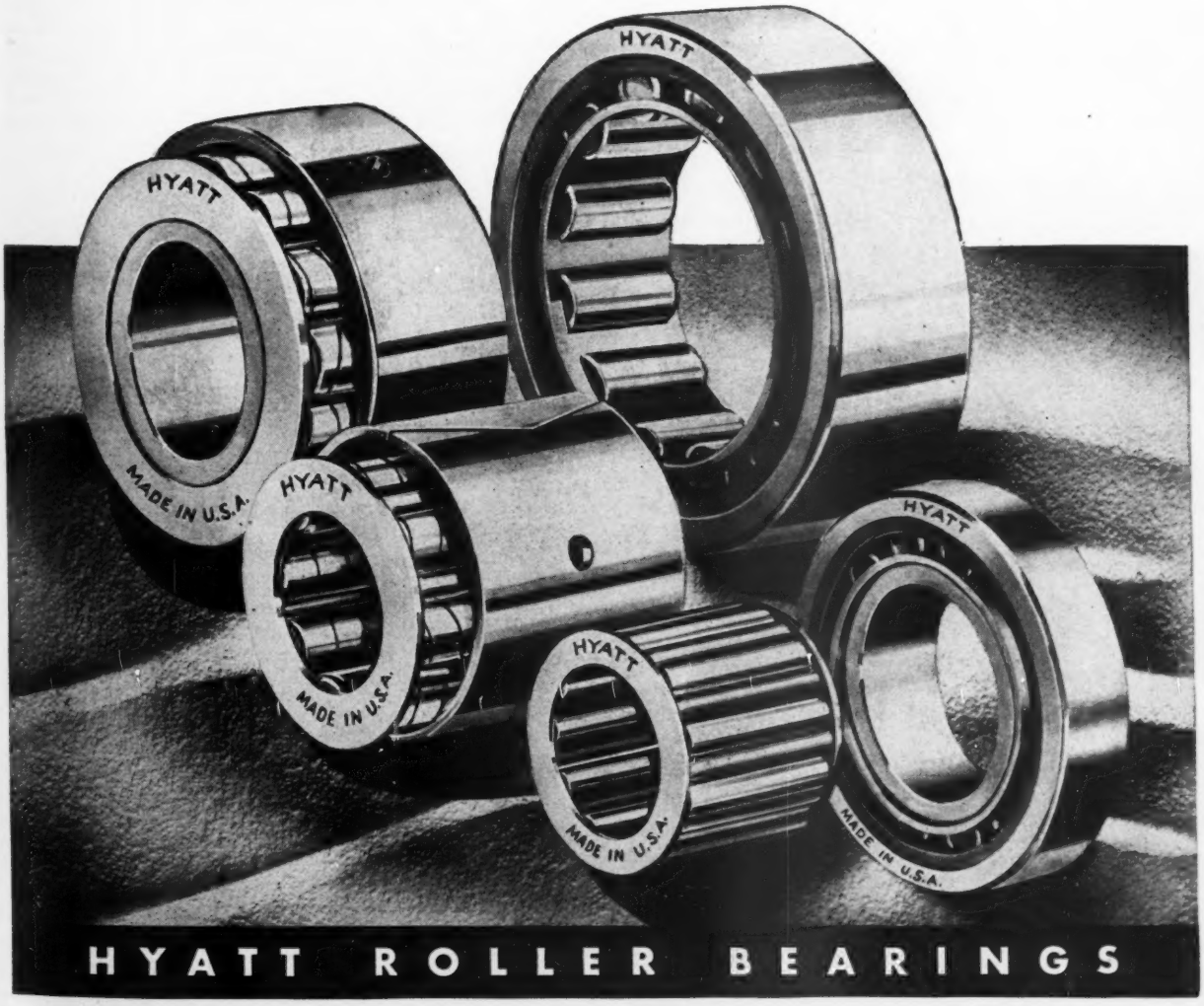
A standard phrase that answers bearing questions in the affirmative.

Leading manufacturers of machines and equipment covering diversified fields quote "Hyatt-Equipped" when they refer to bearing specifications.

Hyatt originated the roller bearing and Hyatt has continued to keep ahead so that it can be truly said—"There is a Hyatt Roller Bearing for every application."

Specializing in roller bearings for fifty-four years, Hyatt engineers have the answers. So put your bearing questions up to them. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.



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FOR
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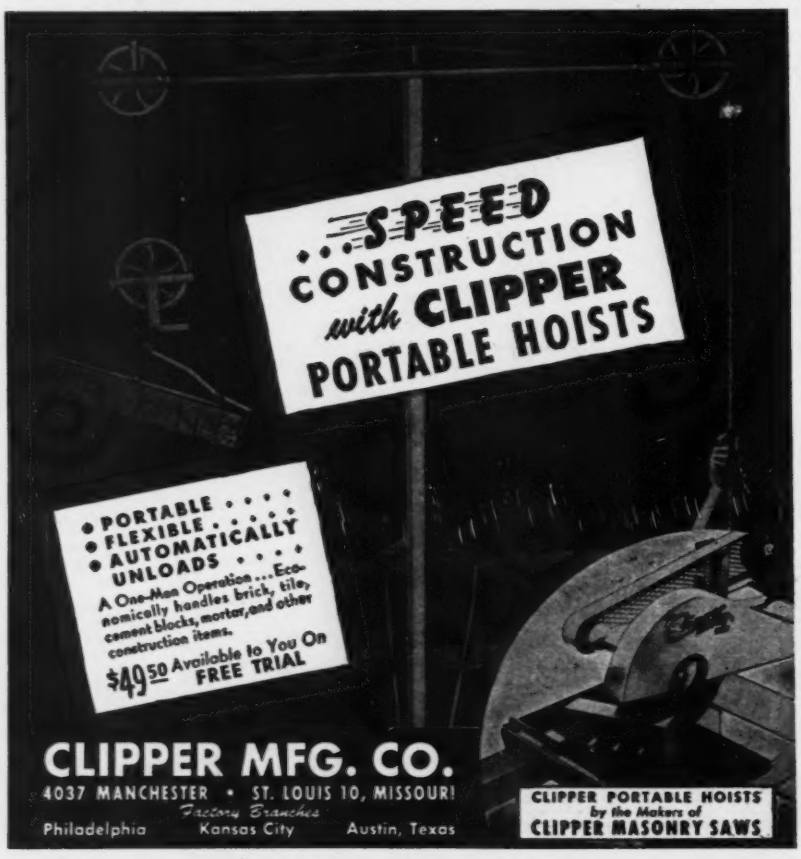


Washington, D. C., for a short period, Mr. Kauer then represented the American Concrete Pipe Association in Washington until 1945 when he became managing director of the Wire Reinforcement Institute.

J. S. Barnard, superintendent of the municipal waterworks at Weaverville, N. C., has also been placed in charge of the town's street maintenance department.

Charles Edward Deslauriers, civil engineer and deputy chief engineer of the Department of Resources of the Province of Quebec, has been named to the Faculty of Science at Laval University, Quebec.

Col. John B. Hughes, recently returned from Europe, has been appointed district engineer at Charleston, S. C., to succeed **Col. Ellin E. Haring** who is retiring from the Army. Colonel Hughes was graduated from West Point, 1918. From 1918 to 1941 he served in the Panama Canal Zone, San Francisco, Fort Peck, Montana, West Point and Washington. During the war he was chief engineer of the ground forces with headquarters in Washington and served as director of Transportation for the Office of Military Government for Germany.

Gordon Ludwig and **Joseph Parkhurst** have been added to a staff preparing to conduct a sewage survey in Orange county, Calif. Both men were with the U. S. Public Health Service prior to accepting their present engineering assignment.

Parley R. Neeley, newly appointed engineer in the Bureau of Reclamation area office at Spanish Fork, Utah, has been placed in charge of surveys for the central Utah reclamation project and the Echo Park Dam.

Carl H. Kadie, Jr., has been appointed district engineer of a newly-formed delta district of the Central Valleys Project, California. He will supervise contracts for the purchase of irrigation, municipal and industrial water and power. He was recently discharged as a lieutenant commander after service with the Navy construction forces in the Caribbean. He worked for the bureau before the war, starting after his graduation from the civil engineering school of Duke University.

Raymond B. Perry has been named by Col. D. E. Elliott of Chicago, Great Lakes division engineer, as representative on navigation matters in the eastern

WIRE ROPE LUBRICATION

New Compound Adds Life to Wire Rope

DOES NOT REQUIRE HEATING . . . CONTAINS A PENETRATING SOLVENT TO ASSURE COMPLETE SATURATION

Rust or corrosion of wire rope is a gradual decay caused by weathering or by special conditions which subject the rope to either acidic or alkaline substances. When corrosion sets in, the rope loses its flexibility. The entire rope starts to wear away rapidly. Then some of the wires become overloaded and break.

Present Methods Take More Time

To protect wire rope from such damage and to enable it to operate satisfactorily, certain protective compounds are used. Wire rope, exposed to the weather, is usually coated with a very viscous, or plastic compound which *must be thinned down by heating* before it can be applied. It is applied by brush or paddle, or better still, by running the rope through the heated compound contained in a trough especially designed for this purpose. However, these operations are costly and time consuming.

Cities Service *Cisco Compound 5-Z* is a new and different wire rope safeguard. Unlike other lubricants, *it does not require heating.*

Solvent Penetrates Rope

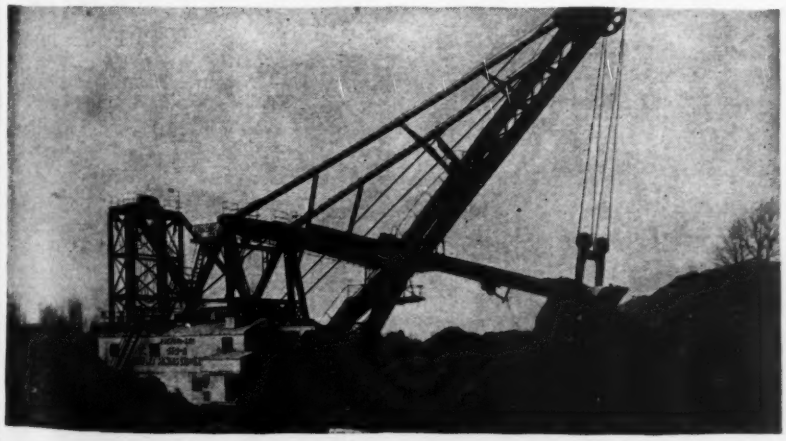
Cisco Compound 5-Z contains a solvent which evaporates in a few hours leaving a *tough, tenacious, durable coating on every wire and strand.* The solvent improves the penetrating powers of the compound and assures complete saturation of the rope. As a result you get longer rope life, greater efficiency, lower operating cost, greater flexibility and greater safety.

Before applying Cisco Compound 5-Z the rope should be cleaned carefully with *Cities Service Penetrating Oil* to remove grit, dirt, and foreign matter. Penetrating Oil not only cleans the wires and strands but *lubricates the core* as well. After cleaning with Penetrating Oil, brush on Cisco Compound 5-Z. It flows on easily with no heating or fuss...assures the rope ample lubrication and protection against wear and atmospheric injury.

Clean Before Lubricating

Through continual contact with the lubrication problems encountered by industry over the years, Cities Service Lubrication Engineers have accumulated considerable information on ways and means for reducing costs and improving the performance of lubricants. See for yourself how they can help *you.* Contact your nearest Cities Service branch office or write to Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y. In the South, Arkansas Fuel Oil Co., Shreveport, La.

Expert Counsel Available



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ONCE-ALWAYS

FOR EVERY LUBRICATION PROBLEM CALL Cities Service FIRST!

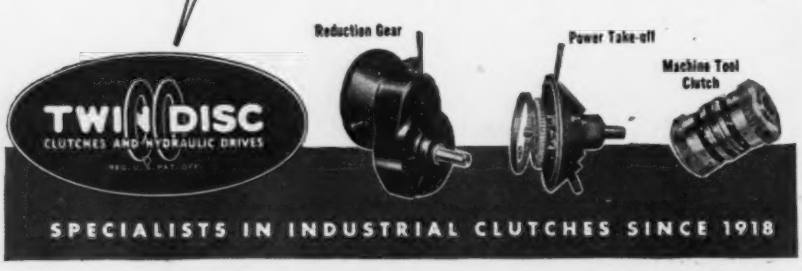
EXPERIENCE
the important intangible

● The number of leading manufacturers who adopt Twin Disc Hydraulic Couplings as standard equipment attest to the proved record of Twin Disc units in heavy-duty service. Important factors in achieving this record are sound engineering and the extreme care taken in the construction of all Twin Disc products.

There also is another reason, an important but intangible reason, for the outstanding performance of Twin Disc units. That reason is experience. When Twin Disc selects a unit from its extensive line of standard products for specific application, that selection is made from the knowledge gained through 28 years of specialized clutch experience . . . in matching job requirements to proved performance characteristics of Twin Disc Clutches or Hydraulic Drives. When you have a problem concerning the control and transmission of power, why not put this long experience to work for you? TWIN DISC CLUTCH COMPANY, Racine, Wisconsin (Hydraulic Division, Rockford, Illinois).

Left above: *The Model EH friction clutch is offered in sizes from 14" to 42" in single or two-plate assemblies.*

Right, above: *Twin Disc Hydraulic Couplings are offered in three sizes, 14.5", 17.5" and 21".*



portion of the division, with headquarters in Cleveland, where he previously was area engineer for the district engineer's office at Buffalo. Perry will act as liaison officer on matters of division policy, while **Frank H. Taylor** will head operations of the engineer's storehouse and shop. Taylor will be representative of Col. H. D. Vogel, the district engineer.

For the first time in its history, George County, Ohio, has a full-time sanitary engineer, with **Clarence S. Holling** in the post. Previously he was sanitary engineer in Jefferson County, and during the war served with the 37th division in the South Pacific.

The Fort Wayne, Ind., City Plan Commission has engaged **Laurence V. Sheridan** Indianapolis, as consulting engineer. A permanent city planning engineer will be named in the near future, to succeed the late Robert B. Hanna.

Mentone, Calif., reservoir begins to receive water

The new 31,000,000-gallon Mentone reservoir of the Bear Valley Mutual Water Co. in California received its first supply of water last month, a few days ahead of schedule.

The reservoir was constructed to even the flow of water from the company's storage lake at Bear Valley to the orchards of the Redlands area. It was formed by scooping out earth at the Mentone site and using the excavated material to make the walls. Walls and bottom were gunited, providing a 2-in. cover of concrete.

Seattle to vote on street light betterment

Although admitting legality of a proposed $3,500,000 bond issue for street lighting improvements is questionable, the Seattle, Wash., city council has placed the proposition on the ballot for the Nov. 5 general election.

Maj. A. A. Oles, secretary-manager of the Building Owners and Managers Association, charged that by putting the bond measure on the ballot the city is attempting to circumvent the 40-mill tax limit law, which prohibits municipalities from asking a vote on more than one bond issue a year. Seattle voters last spring approved a bond issue for construction of a new public safety building and for sewer improvements.

Constitutionality of the law now is being tested in the state supreme court. If the measure is approved by the

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Simplify your construction, make it modern in design, with J-M Corrugated Asbestos Transite. It can't rot, can't rust, can't burn. And it's low in cost, too.

NOTE THE STREAMLINED simplicity of the factory shown above . . . and the unusual decorative effect achieved in the interior of the camera shop.

Here are typical examples showing how Johns-Manville Corrugated Transite is attractively functional, used inside or out.

With its pleasing symmetrical lines and natural stone-gray color, you can use these durable sheets for walls and roofs . . . or as an interior finish . . . on practically every type of building.

You save both on construction and maintenance, because Corrugated Transite requires no upkeep . . . is quickly and inexpensively installed . . . and is 100% salvageable if alterations are required.

The large fireproof sheets are made of asbestos and cement, practically indestructible materials. Their unusual strength is further increased by corrugations—permitting a minimum of framing.

For more facts, send for brochure. Johns-Manville, Dept. EN-10 P. O. Box 290, New York 16, N.Y.

Because of the unprecedented demand for J-M Building Materials, there may be times when we cannot make immediate delivery. We urge you to anticipate your requirements as far in advance as possible.

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EASY TO BOLT TO STEEL

EASY TO SAW

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Johns-Manville *Asbestos* **CORRUGATED TRANSITE**

The New

LIDGERWOOD

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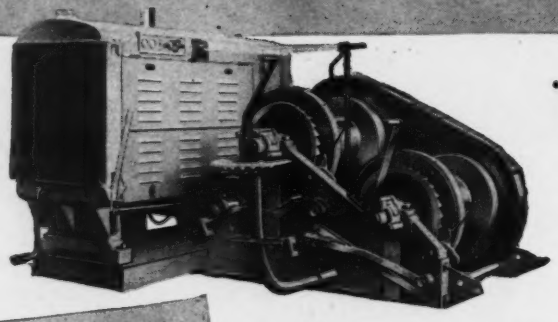

..Its faster load lifting removes construction bottlenecks!

Principal Features

- Ratings from 4,000 to 11,000 pounds single line pull.
- At rope speeds of 200 to 350 feet per minute.
- Diesel, gasoline or electric powered.
- Steel frame construction.
- High-pressure lubrication.
- Anti-friction bearings.
- Grouped levers at operator's seat.

Bring on your tough load lifting problems for this light weight hoist to solve faster, cheaper and better than ever before!

This New Lidgerwood Series of light weight hoists will give faster, dependable, trouble-free service on dozens of construction jobs — that's the way Lidgerwood builds them! The advanced engineering design of this hoist and its compact rugged power are a heritage of 72 years of experience in building only *quality* hoists.

For adequate power, responsive, flexible control, and economical operation get the complete facts on this productive, heavy service, light weight hoist—write us today.

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For ● Steel Plate Lining ● Steel Encasement ● Building Walls, Roofs, Facings ● Tunnel Lining ● Water Reservoir Lining ● Power Plants—Basher Lining ● Sewer Repairs ● Tank Lining ● Canal and Ditch Lining ● Repairs of Disintegrated Concrete, Brick, Tile, Masonry

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voters, it is possible the state legislature at its 1947 session might agree to validate the bonds for the city by changing the statute.

Councilmen decided to proceed with election plans because of the immediate need for better street lighting, especially for traffic safety.

Work on Addicks Dam is being pushed

Men are working on two shifts day and night, or 20 hours a day, to put the construction of the $2,750,000 Addicks Dam near Houston, Tex., up to schedule. Work on the dam was scheduled to begin May 7 but it did not start until July 24 because of heavy rains. The men will be kept working night and day to keep the project going before the heavy winter rains start, according to Wayne D. Tiner, president of the H. B. Zachry Co. of San Antonio, the contractor.

The dam, scheduled to be completed Nov. 1, 1948, is part of a $31,000,000 federal flood control program for Harris County. This program will furnish drainage throughout the county by utilizing the streams in 23 natural watersheds.

The Addicks reservoir will cover 12,000 acres and the dam will be 39 ft. high at the center, tapering to five feet high at the ends. About 7,000,000 yd. of dirt will have to be removed and it is being taken out now at the rate of 16,000 yd. a day.

The dam and reservoir will impound the waters of Turkey and South Mayde Creeks, holding back flood waters and gradually releasing them into Buffalo Bayou.

Success Dam explorations are successful

Explorations at the Success Dam site on the Tule River near Visalia, Calif., so far indicate the site to be satisfactory for a proposed flood control dam, Col. Charles H. McNutt, assistant district engineer for the Army Corps of Engineers, reported.

The colonel's statement answered reports from the district that core holes had been drilled to 95 ft. without striking foundation strong enough for the 153-ft. dam and that it might be necessary to find a new site.

McNutt explained that the test pit had been sunk to considerable depth to prove beyond doubt the quality of the foundation.

He said that studies so far indicate that questions of percolation and seepage of the foundation can be solved very satisfactorily at the Success site.